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NEW SERIES, VOLUME XL

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## EDITORIAL

### THE DEVELOPMENT OF SURGERY OF THE UPPER DIGESTIVE TRACT

KNOWLEDGE of the physiology of digestion began with an operation on the stomach. On June 6, 1822, on the Island of Mackinac, the army surgeon William Beaumont was hurriedly called from the Fort to attend the desperately wounded Canadian habitant, Alexis St. Martin. He found a patient with a shotgun wound of the abdomen that had penetrated the stomach, fractured ribs and torn the lung. The situation appeared hopeless and it is still a mystery why it was not. Beaumont applied first aid, covered the wound with a protective dressing, and had St. Martin carried up the hill to the little post hospital. Later in the day the wound was cleaned of shot, clothing and fragments of bone, an ordeal courageously borne by the sturdy Canadian. There began the long, infinitely tedious convalescence with its struggle against the poorly understood problems of infection, healing and malnutrition.

Ten months passed with slow progress when another crisis arose. St. Martin, hitherto a public charge, was denied further support by the civil authorities and was told to paddle home, a distance of three thousand miles. Beaumont, uniting generosity to his surgical skill and patience, resisted this demand by placing St. Martin in his own home where he continued his surgical ministrations while feeding, clothing and nursing him. Another year passed before the wound healed, leaving a gastric fistula. A modest report of the clinical aspects of the case was made and the surgical phase of the incident was closed. After a study of this report, one must give Beaumont the credit for saving St. Martin's life by his patience, persistence and surgical skill.

In the meantime, the idea of studying the processes of digestion in the stomach had germinated and in June 1825, these investigations were started along a carefully planned

course. Thus began from this most famous of all surgical cases, the association of surgeon and patient that was soon to become a more famous relation of scientist and subject with its extraordinary psychological aspects, its curious accidents and excursions in a frontier setting. Without the original bond of surgeon and grateful patient, the scientific relation between the two probably never could have lasted long enough for the experiments to have been completed. And in after years, in spite of suspicion, irritation and even hatred that is suggested at times in their correspondence and in their contacts, we find the old surgeon-patient feeling reappearing at times as their only mutual bond.

The story is well known, but among the circumstances leading to the foundation of the physiology of digestion, not the least important is the skilful surgical operation and the establishment of the firm personal relationship of successful surgeon and grateful patient. This paved the way for the masterly scientific studies that were to follow, culminating in December 1833, in Beaumont's famous "Experiments and Observations on the Gastric Juice and the Physiology of Digestion." The meager state of chemistry and physiology at that time is startlingly emphasized when we read of Beaumont's struggles to get a chemical analysis of gastric juice and no one in the United States was qualified to carry it out! In the face of innumerable difficulties, not the least of which was his own complete lack of scientific training, Beaumont's achievement must rank him as one of the great geniuses of medicine.

On the foundation laid by Beaumont has grown our present knowledge of the physiology of digestion. Prior to his time, isolated clinical and experimental observations had made known disconnected facts concerning some diseases of the upper portion of the digestive tract. John Hunter described post-mortem digestion of the stomach wall, Matthew Baillie, in his notable work on pathology, described cancer and ulcer of the stomach, and

Spallanzani discovered that gastric juice acted outside the body.

After Beaumont's publication, knowledge grew slowly, keeping pace with the halting progress of chemistry, physiology and pathology. With the advent of anesthesia and the application to surgery of the new science of bacteriology by Lister, abdominal section became possible and the pathology of the living was studied with an enormous increase in our stock of learning about the ills that afflict the organs of human digestion. Technical skill at first was not high, suture lines leaked and operations on the stomach, duodenum and biliary tract were attended by a very high mortality. The work of Kocher, Billroth, Mikulicz, Lembert and later McGraw, J. B. Murphy and Halstead made safe, technical manipulations, enabling the surgeon to try a variety of methods of attack on the lesions that were by now becoming well recognized. Diagnosis of most of the lesions of the upper gastrointestinal tract was still not highly accurate, being based almost entirely on clinical observations.

The application of the Roentgen ray to medicine marked a tremendous step forward in the accuracy of diagnosis, and in our knowledge of the functional behavior of the organs of digestion. The experimental observation of Pavlov had added enormously to our stock of physiologic information, while the investigations of Cannon with the x-ray on the behavior of digestion revolutionized our concept of the entire mechanism of digestion. Diagnosis, which had been positive only when the lesion was hopeless, ceased to be deified guess-work and has become accurate to an amazing degree, due to the skill of the roentgenologist.

In the meantime the surgeon was active, with leaders in this field, as the Mayos, Moynihan, Finney, and a host of others, amassing valuable clinical observations by studies of the reaction of all types of lesions to many varieties of surgical attack. Scientists and clinicians literally

by the hundreds now added their mite to the rapidly developing knowledge in this field. Much individual difference of opinion existed concerning the applicability of different surgical methods, but honest studies of end results over the course of years have gradually excluded operations that proved inadequate and replaced them with procedures that have proven their worth. Operative methods cannot be standardized, nor is it desirable that they become so, but at present there is a large degree of unanimity of opinion concerning operative indications and operative methods.

The past fifteen years have marked a great change in the viewpoint of the surgeon, with a corresponding improvement in his results. In the early days of modern surgery, interest centered on anatomy and pathology with very little attention accorded to the chemical and physiologic aspects of the patient and his disease. Science has advanced in these fields with astounding and ever increasing speed, giving us a firmer groundwork of facts on which to base our technical procedures. Medical education, constantly improving, has given the young surgeon a training that enables him to utilize the new knowledge. At present the surgeon, in treating lesions of the digestive system, must use the chemical laboratory as freely as formerly he used the anatomic and pathologic laboratories without, however, minimizing the importance of the latter.

The present generation of surgeons presents fewer great individual figures with perhaps a gain to the Science of surgery, if not to the Art. The laboratory has replaced the bedside manner. We have gained in tolerance, since we can now recognize that many lesions formerly subjected to operation can better be cared for by the internist. We recognize that no one can be an authority in all fields of medical endeavor and the patient benefits from close cooperation among all fields in medicine. Consultation formerly was the court of last resort and usually just preceded the final rites. Now we seek

consultation before operation by close association of surgeon, internist, roentgenologist and other specialists when needed.

Honest studies of end results showed how frequent was the occurrence of post-operative complications, but clinical and experimental studies have taught us how to prevent many of them. Anesthesia for years remained stationary, but in the past fifteen years, due to its new union with basic sciences and to its study by scientists, has advanced remarkably in safety, flexibility and applicability; and one can prophecy with accuracy further tremendous advances in this field.

No single biologic process is completely understood; no technical procedure but is capable of being improved, and with the more complete amalgamation of surgery with the basic sciences we may rightly anticipate greater and more revolutionary advances in every aspect and branch of surgery.

This new union of surgery and science demands a longer and more closely directed apprenticeship for its mastery. Therefore, definite steps are being taken in advising, supervising and regulating graduate study of the young man entering into all surgical specialties. The demand for such training is now infinitely greater than there are opportunities for acquiring it and we must make such changes in our hospitals as will enable them to satisfy these demands for the best possible training.

Surgery was revolutionized by John Hunter in his day by his application of the scientific knowledge of that time to the stereotyped manual procedures of the ordinary surgeons. In the past twenty years, surgery has undergone a similar change in the application of science to surgery, the union being accomplished by thousands of scientists and surgeons instead of by one man.

It is valuable for anyone practicing surgery to take stock frequently of what the best and latest surgical thought may



be in his field of work. The Editor of The AMERICAN JOURNAL OF SURGERY has done me the honor of allowing me to edit this number devoted to surgery of the upper part of the gastrointestinal tract. Our thanks are due to the busy surgeons who have so graciously prepared the articles at sacrifice of their time and energy,

but who, by their efforts, have given us such a splendid survey of the best surgical practice in this special field today.

Beaumont would be proud could he but see how the physiology he learned from a surgical operation is now applied daily to all surgical operations.

FREDERICK A. COLLIER, M.D.

Subscribers to THE AMERICAN JOURNAL OF SURGERY visiting New York City are invited to make the office of the publishers (The American Journal of Surgery, Inc., 49 West 45th Street, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices.

# ORIGINAL ARTICLES

## THE IMPORTANCE OF GASTROSCOPY IN SURGICAL DIAGNOSIS\*

EDWARD B. BENEDICT, M.D.

BOSTON, MASSACHUSETTS

**G**ASTROSCOPY is now a well recognized diagnostic procedure. It is safe, easy to perform, and gives information not obtainable by any other method.

This discussion is based on a series of 456 gastroscopies performed at the Massachusetts General Hospital, where the Wolf-Schindler flexible gastroscope<sup>1,2</sup> has been in use since early in 1933. In this series there has been one minor complication, but no major complication. Preliminary x-ray examination of the esophagus is always carried out before gastroscopy in order to rule out esophageal disease that would contraindicate the blind passage of the gastroscope. Preliminary esophagoscopy is unnecessary, however, for the flexible gastroscope always passes readily through an esophagus that appears normal to x-ray examination.

Gastroscopy is conducted as an office or out-patient department procedure. As the patient must be fasting, early morning is the best time. Preliminary gastric lavage is usually unnecessary and inadvisable as it may irritate the mucosa, but preliminary drainage by lowering the patient's head with a large stomach tube in place will frequently yield from 1 to 2 ounces of retained secretions and result in a more complete and satisfactory view of the mucosa. For anesthesia of the throat a 2 per cent solution of pantocaine, used as a gargle, has been found sufficient. Codeine,  $\frac{1}{2}$  gr., may be used for sedation.

During the examination the patient lies on the left side with the head extended on pillows or held in the hands of a trained assistant. Only a very few minutes are necessary for complete gastroscopic study, and the patient may go home immediately afterwards. He may eat within an hour of the examination, or as soon as the local anesthesia wears off. Except for slight sore throat, there will be no unpleasant aftermath.

Gastroscopy permits a minute study of almost all the gastric mucosa, but certain blind areas should be mentioned. The duodenum cannot be seen. The pylorus is usually well visualized, but an ulcer lying within the pyloric canal will probably not be visible. In a J-shaped stomach it may be impossible to see the lesser curvature of the antrum near the pylorus. This gastroscopic blind spot is due to angulation and is not always present; during the passage of a peristaltic wave the whole lesser curvature may become visible even in a difficult case. Owing to the fact that the objective lens looks at right angles to the axis of the instrument there is a blind spot on the greater curvature where the tip of the gastroscope impinges on the mucosa. By manipulation of the instrument this area becomes very small. The portion of the fundus above the cardiac orifice and adjacent to the esophagus is also invisible, but is a relatively unimportant area. Except for these small areas, which are of varying visibility and importance in

\* From the Massachusetts General Hospital.

different stomachs, the entire gastric mucosa is usually very well seen.

Indications for gastroscopy include all diseases of the stomach, for there is no intrinsic gastric pathology in which direct endoscopic examination of the mucosa may not give information impossible to obtain by any other method. If gastroscopy were done routinely on all patients with stomach complaints much valuable information would be obtained. Gastroscopy is easier to perform than cystoscopy and should bear much the same relationship to gastroenterology that cystoscopy bears to urology. In general we may say that gastroscopy is indicated in many cases of benign tumor, malignant tumor, gastric ulcer, duodenal ulcer, gastritis, unexplained gastric symptoms, such as indigestion, dyspepsia, sour stomach, etc., gastric neurosis, hematemesis, melena, pernicious anemia, post-operative gastritis, and gastrojejunal ulcer.

*Benign Tumor.* Gastroscopy in benign tumor of the stomach will indicate the location of the growth, its general appearance, its basic attachment to the stomach wall, and the condition of the surrounding mucosa. Thus assistance will be obtained in determining whether the tumor is really benign, or possibly already malignant, and in deciding the question of operability and extent of operation necessary. Small tumors with a broad base or an ulcerated surface are likely to be malignant. Adenomatous polypi, although benign in their early stages, are likely to become malignant<sup>3,4</sup> and, if not resected at once, should be carefully observed gastroscopically. Occasionally cases thought to be benign tumor will be shown by gastroscopy to be due to foreign body.

*Malignant Tumor.* In malignant neoplasm of the stomach gastroscopy aids in making an early diagnosis, in confirming a diagnosis already made, in differentiating benign from malignant lesions, and in determining the extent and operability of a malignant tumor.<sup>5,6,7</sup> The early diagnosis of cancer is a goal toward which we are all

striving, and will be definitely hastened when more patients have a gastroscopic examination at the first sign of stomach trouble. Gastroscopy to confirm a diagnosis may occasionally show no lesion at all in the area suspected, in which case further x-ray examination must be carried out, but, on the other hand, it may reveal a much more extensive process than was anticipated. In such cases surgical plans will be materially altered. In some instances gastroscopy has been of definite assistance when the question arose as to whether a mass close to the stomach wall was intrinsic or extrinsic. When other types of gastric malignancy, as lymphoma or sarcoma, are suspected clinically or roentgenologically, gastroscopic examination may be of very great importance in excluding or confirming the diagnosis.

*Gastric Ulcer.* Contrary to the clinical impression in America that duodenal ulcer is more common than gastric ulcer, a recent study<sup>8</sup> of 457 peptic ulcers at necropsy revealed 240 gastric ulcers, 215 duodenal ulcers, and 2 jejunal ulcers. In Europe as well, gastric ulcer is reported to be more common than duodenal ulcer. It may be anticipated that, with the more frequent use of the gastroscope in this country, the clinical diagnosis of gastric ulcer will be much more frequent. Although it is not possible to see all gastric ulcers,<sup>9</sup> the direct endoscopic observation of a gastric ulcer gives much valuable information not otherwise obtainable regarding (1) the benign or malignant nature of the ulcer, (2) its ability to heal, and (3) the amount of associated gastritis.

An ulcer with sharp margins and a clean base is likely to be benign, but an ulcer with a slightly nodular margin and a dirty base is likely to be malignant. Schindler<sup>5</sup> has emphasized that the gross differentiation between benign and malignant gastric ulcer is easier by gastroscopic observation of living tissue than by pathologic observation of dead tissue, for in the former the presence of the circulating blood and the

direct inspection of the tissues in their normal colors is of great assistance.

Only by gastroscopy can the complete healing of a gastric ulcer be shown. The disappearance of the niche by x-ray examination does not necessarily mean that epithelialization has taken place, for the crater may be filled with mucus and so may fail to fill with barium, or a very small crater may not be demonstrable roentgenologically.

The amount of gastritis associated with gastric ulcer is variable. In my experience there is usually evidence of gastritis in the neighborhood of the ulcer. This may manifest itself by the presence of mucosal hemorrhages, pigment spots, verrucous elevations in the mucosa, and mucosal erosions. In the presence of a severe generalized hypertrophic gastritis associated with a gastric ulcer, good results cannot be expected from a local excision of the ulcer. In fact, even with extensive gastric resection large areas of gastritis may remain and the surgical result will be problematical. When surgery becomes imperative due to failure of medical treatment, danger of malignant degeneration, or hemorrhage, the surgeon should know the amount of gastritis present so that he may decide on the type and extent of the operation to be performed.

*Duodenal Ulcer.* An ulcer in the duodenum is not visible by gastroscopy, but in duodenal ulcer, as in gastric ulcer, there is usually an associated gastritis.<sup>10</sup> The degree of gastritis varies from a slight amount of superficial gastritis to very severe hypertrophic gastritis with erosions. The usual location of the process is in the body of the stomach, but when there is pyloric obstruction, superficial gastritis of the antrum is common, and the gastroscopist will frequently demonstrate increased reddening, mucosal hemorrhages, pigment spots, and hemorrhagic erosions. When a severe hypertrophic gastritis is present, with verrucous elevations in the mucosa, erosions, and superficial ulcerations, it must be recognized that we are dealing with

more than a simple duodenal ulcer, and the treatment must be planned accordingly. Gastric ulcer is a not infrequent accompaniment of duodenal ulcer, and may be demonstrated gastroscopically. The treatment of duodenal ulcer may thus be considerably modified after a detailed study of the gastric mucosa by gastroscopy.

*Chronic Gastritis.* In this disease, the commonest of all gastric disorders, gastroscopy is recognized as the best method of examination,<sup>11,12,13</sup> for only by direct inspection of the mucosa can we demonstrate the finer changes seen in chronic gastritis. In general, chronic gastritis may be subdivided into three types, superficial, hypertrophic, and atrophic, but sometimes more than one type will be present in the same stomach, and a strict adherence to classification will be impossible.

*Superficial Gastritis.* The changes seen in superficial gastritis are increased reddening of the mucosa, edema, and exudate. Small erosions may be present. There may be bleeding from the inflamed mucosa, or from the erosions. It is important for the surgeon to realize that hemorrhage may occur in superficial gastritis. Gastroscopic examination in such cases will therefore save unnecessary surgical exploration.

*Hypertrophic Gastritis.* The changes seen by gastroscopy in hypertrophic gastritis consist in elevations in the mucosa varying in degree from granular or verrucous, to a nodular or even polypoid size. Irregular creases are visible in the mucous membrane and the rugae may have a beaded or caterpillar-like appearance, sometimes ending abruptly or in a bulbous manner. The mucosa itself, normally glistening with many highlights, appears dull, with few or no highlights. Erosions and superficial ulcerations are very frequently present.

Hypertrophic gastritis is a very important disease from a surgical standpoint because it may be the source of severe hemorrhage.<sup>5,14,15,16,17</sup> Massive, even fatal hemorrhage has occurred from gastritis alone. Gastroscopic examination in such cases not infrequently reveals the exact

source of the bleeding, or may show a very diffuse inflammatory hemorrhagic process.

Surgery is contraindicated. In the past many patients have suffered a fruitless surgical exploration because of unexplained hematemesis or melena under the erroneous supposition that a peptic ulcer had been overlooked, whereas in reality the bleeding was coming from a severe chronic gastritis with multiple erosions.<sup>18</sup> The surgeon must also be familiar with the fact that chronic hypertrophic gastritis may simulate peptic ulcer in symptomatology, or may present a very variable picture.

A positive gastroscopic diagnosis of hypertrophic gastritis is often a satisfactory solution to the case with vague and otherwise unexplained gastric symptoms, such as indigestion, gas, heartburn, dyspepsia, sour stomach, etc. Such cases, often given an unjust and erroneous diagnosis of gastric neurosis in the past, will require medical treatment, but the surgeon will frequently be called upon to direct the methods used in differential diagnosis.

*Atrophic Gastritis.* The mucosa in atrophic gastritis is very pale, and so thin that the blood vessels of the submucosa are plainly seen. The gastroscopic picture is unmistakable. It is a condition seen in deficiency diseases, notably pernicious anemia. Liver therapy improves the condition of the gastric mucosa.<sup>19</sup>

The surgical significance of atrophic gastritis lies in the fact that gastric neoplasm probably arises more commonly from an atrophic mucosa than from apparently normal mucosa.<sup>20, 21, 22</sup> Because of our interest in atrophic gastritis, several cases of deficiency disease have been examined here gastroscopically, and in two of them (one a pernicious anemia, the other a Plummer-Vinson syndrome) polypoid tumors of the stomach have been discovered, confirmed by x-ray examination, and resected. Both were thought to be malignant, and were so proved on pathologic examination.

*Post-Operative Gastritis.* Gastroscopists are generally agreed that chronic gastritis

is to be found frequently after gastric operations, whether pyloroplasty, gastroenterostomy, or partial gastric resection. Whether this is due to the altered gastric physiology is not known. Many stomachs before operation exhibit more or less chronic gastritis in association with the peptic ulcer or carcinoma for which the operation was undertaken. This gastritis may persist following operation, further inflammatory changes may take place, or, if no gastritis was evident before operation, it may develop after operation. Any of the mucosal changes already described in superficial or hypertrophic gastritis may be found in post-operative gastritis. When intractable symptoms persist and gastroscopy shows the presence of a severe gastritis, further surgery may be necessary, as, for example, undoing of a gastroenterostomy, or further gastric resection.

*Gastro-Jejunal Ulcer.* Marginal ulcers are sometimes, but not always, well seen by gastroscopy. It is not to be expected that jejunal ulcers far removed from the stoma will be seen. Gastroscopy should be done in cases of suspected gastrojejunal ulcer, for in addition to a direct inspection of the ulcer, gastritis and perhaps multiple ulcerations may be found, and the treatment of the disease modified accordingly.

#### CASE REPORTS

In the following case, in which autopsy showed carcinoma of the stomach, more attention should have been paid to the gastroscopic report:

CASE 1. E. D. S. (M.G.H. 9253), a white American male of 68, first entered the hospital in August 1934, because of 20 pounds' weight loss in three months. There were no symptoms whatever referable to the gastrointestinal tract.

*Past History.* This was not remarkable except for an excessive use of alcohol for a thirty year period as a young man, urethral stricture, and a mild diabetes of three years' duration. It was thought possible that the diabetic diet might be responsible for the weight loss.

*Physical examination* was essentially negative.

*Laboratory Findings.* R.B.C. 5.6 million. Hemoglobin 90. The stool was guaiac-positive on three examinations. Gastric analysis showed no free acid in the fasting content or one hour after histamine. The fasting blood sugar was 171 mg. per 100 c.c.

*X-ray Examinations.* On seven different examinations done over a two year period from August 1934, to July 1936, it was impossible to make a positive diagnosis. There was a deformity in the prepyloric region, but it was impossible to say whether this was due to neoplasm, ulcer, or inflammation. An early report suggested a small neoplasm; later reports, while showing much the same lesion, indicated slight improvement and tended toward a non-malignant diagnosis.

*Gastroscopy.* In October 1934, gastroscopy showed very irregular areas on the lesser curvature and posterior wall, consistent with marked hypertrophic gastritis or with infiltrating malignancy. Exploratory laparotomy was urged by the gastroscopist unless malignancy could be positively excluded by x-ray. The patient gained weight and strength and continued symptom-free.

In December 1934, a repeated gastroscopy showed irregular and slightly nodular appearance of the lesser curvature, consistent with hypertrophic gastritis but not excluding neoplasm.

*Clinical Course.* The patient continued to do well as regards his stomach, and attention was focused on his diabetes and hypertrophied prostate, for which prostatectomy was performed in September 1935. In March 1936, it was noted that his appetite was poor and his weight was six pounds lower than it had been a year previously, although at least ten pounds higher than it had been after prostatectomy. Anorexia was again noted in February 1937, but in April the only symptom referable to the gastrointestinal tract was a little indigestion. There had, however, been marked weight loss. In May 1937, he died at another hospital.

The autopsy showed confluent bronchopneumonia and extensive carcinoma of the stomach with regional extension and metastases to the lungs, liver, mesenteric and periaortic lymph nodes, and ileum.

*Comment.* Gastroscopy here was more accurate than any other method of examination. More weight should have been

placed on the gastroscopic findings. The age of the patient, absence of symptoms, slow rate of growth, and complication of diseases were, however, extenuating circumstances.

In the following case of severe gastric hemorrhage, gastroscopy demonstrated gastric ulcer with superficial and hypertrophic gastritis:

CASE II. M. E. M. (M.G.H. 15015), a 35 year old American truck driver, entered the hospital in September 1937, because of hematemesis. There had been two severe episodes of bleeding, one eight months prior to admission, when he vomited about a pint of blood, and the other two days before admission, when he had repeated hematemesis of a cupful or more of changed blood.

The past history was negative.

*Physical Examination.* There were marked pallor and dehydration. Blood pressure was 108 systolic, 68 diastolic.

*Laboratory Findings.* R.B.C. 2.5 million, hemoglobin 50 per cent. W.B.C. 18,000. The stools were positive for guaiac on three occasions.

X-ray examination eight months previous, three weeks after the first episode, was negative except for moderate hypertrophic gastritis. Severe hematemesis continued for several days after admission, and the red count fell to 1.5 million. A repeated x-ray examination twelve days after the second episode was inconclusive.

*Gastroscopy* two days later showed a superficial 1 × 2 cm. ulcer on the anterior wall of the stomach near the cardia. Marked superficial and hypertrophic gastritis of the upper part of the body and fundus of the stomach was also demonstrated.

*Clinical Course.* In view of these findings it was felt that surgery was definitely contraindicated. Under medical treatment he became asymptomatic about one month after admission, at which time x-ray examination showed unusually marked hypertrophic gastritis and active duodenal ulcer. Two months after discharge from the hospital this patient was entirely symptom-free and able to go back to work.

*Comment.* Gastroscopy here demonstrated a very extensive superficial and hypertrophic gastritis of the body and

fundus of the stomach with a gastric ulcer high up near the cardia. These gastroscopic findings constituted a definite contraindication to surgery in this case.

The following case shows how important gastroscopy may be in a case of duodenal ulcer:

CASE III. P. S. (M.G.H. 91374), a 43 year old Greek housewife, entered the hospital November 10, 1937, complaining of epigastric pain and vomiting.

Two months previous the epigastric pain had begun, usually relieved by milk. Three weeks before admission, there was fulness, with vomiting of sour material at two or three day intervals.

The past history was negative, and physical examination was also negative except for epigastric fulness.

*Laboratory Findings.* Urine, blood, stools, and gastric analysis were essentially normal.

X-ray examination on two occasions demonstrated a 0.5 cm. duodenal ulcer without other pathology.

*Clinical Course.* Because of obstinate obstructive symptoms it was felt that surgery was indicated, but this was delayed.

*Gastroscopy* demonstrated superficial and hypertrophic gastritis, a gastric ulcer near the cardia, and multiple gastric erosions with active hemorrhage.

Under medical management, including psychotherapy, this patient showed a striking improvement and was discharged home without operation.

*Comment.* In view of the gastroscopic findings surgery was contraindicated in this case.

In the following case no satisfactory diagnosis was reached until gastroscopy showed chronic gastritis with erosion:

CASE IV. J. G. L. (B.M.H. 78062), a married American housewife of 69, entered the hospital on September 8, 1937, as a patient of Dr. B. T. Guild.

There had been occasional irregular attacks of dull epigastric pain, nausea, and vomiting of fifteen years' duration, anorexia, debility, and loss of 30 pounds in weight in the past two years, and very dark stools for the past month.

The past history was non-contributory. Physical examination revealed a pale and undernourished woman.

*Laboratory Findings.* R.B.C. 3.0 million. Hemoglobin 50 per cent. The smear was normal except for moderate achromia. The urine was negative. The stool was guaiac-negative on three examinations.

*X-ray Examination.* A gastrointestinal series was negative except for diverticuli of the fundus of the stomach and the second portion of the duodenum. A barium enema gave negative results. The Graham test was negative.

*Gastroscopy* showed a 3 mm. erosion just proximal to the musculus sphincter antri with marked superficial and hypertrophic gastritis.

*Comment.* In this case gastroscopy not only revealed the source of the hemorrhage, but also indicated that a severe gastritis was the cause of the long-standing gastric complaints.

#### CONCLUSIONS

Gastroscopy with the flexible gastroscope is safe and easy to perform.

Gastroscopic examination gives information not obtainable by any other method.

Indications for gastroscopy include benign and malignant gastric neoplasm, gastric, duodenal, and jejunal ulcer, and superficial, hypertrophic, atrophic, and post-operative gastritis. In many cases of gastrointestinal hemorrhage, vague gastric complaints, gastric neurosis, and deficiency disease, gastroscopy should be performed.

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ACTINOMYCOSIS may be primary in the [salivary] gland itself, after gaining entrance through the duct, but usually it is secondary to involvement of neighboring infected tissues.

From—"Surgical Diseases of the Mouth and Jaws" by Earl Calvin Padgett (Saunders).



# NUTRITIONAL DISTURBANCES ASSOCIATED WITH DISEASES OF THE STOMACH AND DUODENUM\*

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TO view surgical lesions of the stomach and duodenum from the standpoint of etiology, symptoms and signs, pathology, and operative correction is to miss much. Altered physiology and biochemistry are also important and the surgeon of today has broadened his field to understand and correct the deficiencies resulting from nutritional disturbances. These deficiencies may be associated with the vitamins, minerals, proteins, carbohydrates and fats, either individually or in combination.

Caloric requirements cannot always be entirely provided for, but even with complete pyloric obstruction, energy for many days is obtained since the body oxidizes its own tissues. The parenteral administration of glucose is a distinct aid in preventing ketosis; actually sufficient glucose can be given to maintain the glycogen reserves of the body at a fair level. However, the substances that can be administered in quantities by the intravenous channel—water, glucose and sodium chloride—are inadequate by themselves to maintain health for more than two or three weeks. Vitamins and proteins are also needed and these requirements are often a considerable problem for the seriously ill patient. For many of them the period of malnutrition has existed for months before the operation, and a long-standing deficit is present. The purpose of this paper is to review briefly the vitamin and protein deficiencies as they may affect the surgical patient with a lesion of the stomach or duodenum.

## VITAMIN DEFICIENCIES

In 1934, Strauss<sup>1</sup> presented an excellent article on the rôle of the gastrointestinal

trace in deficiency disease, in which he pointed out that disturbances in digestion and absorption, as by vomiting, diarrhea or dysentery, are in the north temperate regions a more frequent cause of deficiencies than inadequate composition of the diet. McCollum,<sup>2</sup> in 1937, summarized the recent advances in nutritional research and Youmans,<sup>3</sup> at about the same time, stressed the recognition of the mild or early forms of deficiency, which must be much more common in many groups of seriously ill surgical patients than is realized. This subject merits closer attention from the surgeon.

*Vitamin A.* A case of night blindness due to a nutritional deficiency associated with a gastrocolic fistula was reported by Wilbur and Eusterman<sup>4</sup> in 1934. The patient had had a gastroenterostomy for a duodenal ulcer in 1919, and in 1929 symptoms of jejunal ulceration appeared. Two years later, in 1931, diarrhea from a gastrocolic fistula began, and periods of night blindness occurred. The four to six semi-soft stools daily contained undigested food particles. Following operative closure of the fistulous connection the diarrhea and the night blindness disappeared.

Studies have shown that night blindness, or difficult vision in faint illumination, depends upon a disturbance in the metabolism of visual purple of the retinal rods and that the disturbance is related to a vitamin A deficiency. Milder forms of the deficiency, short of actual night blindness, are rather common; Corlette, Youmans, Frank and Corlette<sup>5</sup> recently reported that 50 per cent of a representative group of adult clinic patients in the mid-south

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showed vision below normal standards by the photometer test.

Vitamin A deficiency may also be manifested in a keratinization of epithelial cells in glands and their ducts, and in many organs. Wolbach<sup>6</sup> presents an excellent discussion of this pathologic change among others resulting from vitamin deficiency. As a test for this keratinization Blackfan and Wolbach<sup>7</sup> made smears from conjunctival scrapings, which, when stained, showed the abnormal presence of cornified epithelial cells. Skin changes suggested by Frazier and Hu<sup>8</sup> as diagnostic, consist of keratotic papules of varying size arising from pilosebaceous follicles, and commonly found over the thighs, arms and shoulders. In two of Youman's<sup>3</sup> patients these lesions cleared up after treatment with cod liver oil.

Fish oils contain large amounts of vitamin A and are therefore commonly used for treating this deficiency. Carotene,<sup>1</sup> a precursor of vitamin A, can be given as a rich source of the vitamin. The oils are less expensive, however, and have other vitamins present.

*Vitamin B<sub>1</sub>.* The most common cause of peripheral polyneuritis in this country is the dietary deficiency associated with chronic alcoholism. Lettsum<sup>9</sup> first described alcoholic polyneuritis in 1787 and for decades thereafter the disease was thought to be a direct effect of alcohol. In 1928, Shattuck<sup>10</sup> suggested that the poor diet of the chronic alcoholic was the cause of the disturbance, and subsequent studies have corroborated this opinion. Evidence now is even more specific, the disease being considered as due to a deficiency of vitamin B<sub>1</sub>.

In a few cases, surgical lesions of the gastrointestinal tract have been responsible for peripheral polyneuritis. The disorder has been secondary to pyloric stenosis associated with peptic ulcer and gastric carcinoma and polyps, and also secondary to gastroenterostomy and to persistent vomiting following biliary tract operations. That the failure of the gastrointestinal

tract to retain food can result in this deficiency is further shown by the occurrence of peripheral polyneuritis in case of "pernicious vomiting" of pregnancy.<sup>1</sup>

Mild or subclinical forms of vitamin B<sub>1</sub> deficiency are undoubtedly widespread, but are very difficult to diagnose. Many people so afflicted drag about with anorexia, vague pains, weakness, indigestion and hypotonicity of the bowel. A calculation of the vitamin B<sub>1</sub> inadequacy of the diet by Cowgill's formula<sup>11</sup> promises to be very helpful.<sup>12</sup> Trial by treatment is also worthwhile when deficiency is suspected.

In the treatment of mild forms of vitamin B<sub>1</sub> deficiency or of actual multiple polyneuritis, yeast or yeast concentrates are commonly used.<sup>2</sup> A pure crystalline form of vitamin B<sub>1</sub> is now available and can be given parenterally. Vorhaus, Williams and Waterman<sup>13</sup> reported excellent results with this substance in over 100 cases of deficiency. Weiss and Wilkins<sup>14</sup> more recently used the crystalline preparation, among other substances, in the treatment of cardiovascular disturbances associated with vitamin B<sub>1</sub> deficiency and obtained remarkable improvements.

*Vitamin B<sub>2</sub>.* Pellagra, as commonly seen in its endemic form, is due to a deficiency of vitamin B<sub>2</sub>. The sporadic cases in the northern part of the country are almost always associated with organic diseases of the gastrointestinal tract or with chronic alcoholism.<sup>1</sup> Eusterman and Balfour<sup>15</sup> found pellagra to be the most common vitamin deficiency encountered in disorders of the stomach and duodenum. Actual primary lesions reported as causes of pellagra<sup>1</sup> are: pyloric obstruction from gastric carcinoma or peptic ulcer; unnecessary gastroenterostomy; gastric syphilis; esophageal stricture; jejunostomy feedings; ulcerative colitis; amebic dysentery; jejunal stenosis; ileac stenosis; and rectal stricture. As mentioned previously, besides the importance of inadequate intake of food, other factors, such as failure to retain the food through obstruction or diarrhea, and failure properly to assimilate

the food, also play a significant part in producing the deficiency.

In the recognition of pellagra associated with gastrointestinal disease, the cutaneous changes on the exposed parts of the body, the hands, wrists, and face are most important.<sup>15</sup> The common lesions may vary from a hyperkeratosis and blotchy pigmentation to extensive bullous lesions. With chronicity the skin becomes hardened, rough, scaly and permanently pigmented. The distribution on the wrists and forearms has repeatedly earned the phrase "gauntlet" or "glove" dermatitis. Usually the lesions associated with gastrointestinal disorders are less severe than those observed in pellagrous regions, and hyperkeratoses with a dryness and scaliness of the skin suggests a mild deficiency. The tongue, which in severe disturbances is red, swollen, dry and ulcerated, in mild cases is merely reddened and smooth along the sides and tip. Field<sup>16</sup> has found the skin and tongue signs of mild deficiency to be quite common among hospital patients in Ann Arbor. The constant presence of diarrhea in the severe cases is often absent or replaced by constipation in the milder forms. Commonly associated with dermatitis and diarrhea in severe pellagra, is dementia. This usually is in the form of a delirium similar to that seen in other infectious or toxic states.

The treatment of secondary pellagra is inseparably connected with the treatment of the primary gastrointestinal disease. Pre-operative dietary measures should be carried out if at all possible. In many cases the operation, as, for example, the relief of pyloric obstruction, has to come first. Later, the addition of proper foods should be started as soon as possible; yeast, eggs, milk, the juices of citrous fruits, cod liver oil, lean meat and green vegetables are particularly essential. Yeast or yeast concentrates require special emphasis because they apparently contain all of the "B-factors" and can be given when patients are taking only fluids. Liver extracts have been shown to be of value

in pellagra, but it is rather unfortunate that present day parenteral preparations for pernicious anemia have been so purified that possible vitamin B<sub>2</sub> elements have been largely eliminated. Within recent months nicotinic acid has been employed and has shown promising results in the treatment of pellagrins.<sup>17</sup>

*Vitamin C.* Interest in vitamin c is now largely concerned with the recognition of early signs of the deficiency, since typical scurvy is quite rare. The pure vitamin substance, known as ascorbic or cevitamic acid, has been synthesized by several procedures and is relatively inexpensive.

Many observers believe that mild or latent scurvy is quite common. Yavorsky and King<sup>18</sup> estimate that at post mortem 20 per cent of the subjects show mild deficiency. Youmans, Corlette, Akeroyd and Frank<sup>19</sup> found latent scurvy in twelve of fifteen adults whose diets were suspected of being inadequate in vitamin c. For the better detection of mild deficiency, methods have been developed for the determination of (1) the urinary excretion,<sup>20</sup> (2) the body store,<sup>20</sup> and (3) the blood plasma or serum concentration of cevitamic acid.<sup>21,22</sup> A further promising test<sup>23</sup> consists in the production of venous stasis in an arm for fifteen minutes with a blood pressure cuff at 50 mm. of mercury and then the counting of the number of petechial hemorrhages in a skin area of 60 mm. in diameter in the antecubital fossa. A positive test consists in the presence of more than eight petechiae; five or fewer constitute a negative reaction.

With the problem of hemorrhage in surgical patients it is odd that little mention is made of vitamin c. The tests developed and the availability of cevitamic acid should lead to studies in this regard.

*Vitamin D.* The association of vitamin D with rickets is well known. Further studies connected it with the development of the teeth and with osteoporosis, osteomalacia, tetany and some forms of pathologic fractures. Definite deficiencies in vitamin D have been secondary to gastro-

intestinal diseases<sup>1,3</sup> in which the absorption of food has been interfered with, such as in celiac disease, sprue, external biliary fistula and chronic jaundice. Excellent reports by Ivy, Shapiro and Melnick,<sup>24</sup> McNealy, Shapiro and Melnick,<sup>25</sup> and Boys<sup>26</sup> are available to show the value of viosterol in lessening the hemorrhagic tendency in patients with jaundice.

*Anemia.* Anemia is not known to be due to a vitamin deficiency, but is frequently associated with nutritional disturbances. The blood picture secondary to diseases of the gastrointestinal tract<sup>27</sup> varies considerably in type and extent. In the absence of gross bleeding, patients with gastric or duodenal ulcers usually show little change from the normal. On the other hand, patients with gastric carcinoma generally show a secondary anemia as a result of a continual oozing of blood from the carcinomatous surface. The degree of anemia found in such cases has been reported as roughly proportional to the extent of the lesion.<sup>28</sup>

Achlorhydria is a common finding in both gastric carcinoma and pernicious anemia. Although not with the frequency one might expect, these two diseases have been coexistent. Conner and Birkeland<sup>29</sup> reviewed twenty such cases, and in most instances found the onset of the gastric carcinoma and the pernicious anemia to be approximately simultaneous.

Pernicious anemia has followed partial gastrectomy for carcinoma, ulcer and syphilis of the stomach, and also gastroenterostomy for peptic ulcer. Goldhamer<sup>30</sup> summarized the findings in twenty-three such cases and pointed out that a number of years generally passed before the pernicious anemia became apparent.

The treatment to be carried out for the anemias depends largely upon the type. The secondary anemias of hemorrhage respond well to large doses of iron; iron and ammonium citrate, reduced iron and ferrous sulphate are quite satisfactory. For pernicious and other forms of hyperchromatic anemia, liver therapy is indicated.

## PROTEIN DEFICIENCY

Among surgical patients with malnutrition from serious disturbances of gastrointestinal function, the effects of protein deficiency are more frequently seen than are those of vitamin deficiencies. Prolonged low protein ingestions result in low plasma proteins, and "nutritional edema" as rather common sequelae. Jones and Eaton,<sup>31</sup> in 1933, presented a series of thirty-four patients who showed edema following operations, mainly operations on the gastrointestinal tract. The majority of the patients were undernourished prior to operation because of malignancy, pyloric obstruction and similar conditions. Most of them had serum proteins below the critical level of Moore and Van Slyke<sup>32</sup> at which edema tends to develop (a total serum protein of  $5.5 \pm 0.3$  Gm. per 100 c.c.; serum albumin  $2.5 \pm 0.2$  Gm. per 100 c.c.).

Besides the low serum protein, Jones and Eaton<sup>31</sup> considered profuse surgical drainage, the general effects of sepsis, loss of serum protein by massive hemorrhage, a retention of base due to temporary disturbance of renal function, and the administration of excessive amounts of water and salt as additional factors in the production of edema. The latter is of particular importance, since seriously ill patients presenting malnutrition or sepsis were shown by Coller, Dick and Maddock<sup>33</sup> routinely to develop water retention if water requirements were supplied intravenously in the form of saline solutions and sodium chloride was not needed. This occurred, as suggested also by Jones and Eaton, even when the serum protein level was approximately normal. While all the factors mentioned set the stage for the development of edema in surgical patients, in the experience of Coller, Dick and Maddock the administration of unnecessary amounts of saline solution to patients with malnutrition or sepsis was almost invariably the common agent precipitating the edema. From an experimental study on dogs involving low serum proteins

Weech, Snelling and Goettsch<sup>34</sup> agree with other investigators that salt is essential for edema. In a recent publication Curphey and Orr<sup>35</sup> stress the relationship of low serum protein and excess sodium chloride to edema. The first thought of the surgeon on finding edema in a sick surgical patient who has been receiving fluids parenterally should therefore be: "What are the serum protein values and how much sodium chloride has been given?"

Studies have shown that the sodium radical rather than the chlorine ion is the important factor in water retention,<sup>36</sup> and sodium is therefore to be avoided. Nevertheless, water has to be given parenterally to many surgical patients to provide for urine output and vaporization from the skin and lungs. If administered intravenously as 5 per cent dextrose in distilled water, it rarely produces edema.<sup>33</sup> It is unnecessary and even harmful to the sick patient to administer more than a few grams of sodium chloride daily when the plasma chlorides and the carbon dioxide combining power are normal and no abnormal loss of sodium chloride is occurring. The only reason that retention of water is not more evident when saline solutions are used routinely without thought as to whether or not sodium chloride is needed is that the administration is generally for a day or two only. With saline administrations for several days edema would certainly appear.

In the majority of cases the damage done by edema fluid is not clearly apparent, but in others the harmful effects are quite striking. Five of the patients reported by Jones and Eaton developed edema of the lungs and in several others impairment of function of a gastroenterostomy was thought to be due to edema of the gastrointestinal wall. Ravdin and his associates<sup>37,38</sup> have shown this latter possibility to be a fact. In an excellent piece of experimental work on dogs, the gastric emptying time was found to increase as the serum proteins were decreased. This occurred

whether the stomach was intact or had a gastroenterostomy. At post-mortem the gastric stoma of the latter dogs showed a marked reduction in size because of edema.

The significance of these important findings should be apparent to all surgeons. As Kirklin<sup>39</sup> and Barden, Ravdin and Frazier<sup>40</sup> have pointed out, roentgenologic findings showing gastric retention after operations should be cautiously interpreted as evidence of mechanical obstruction at the site of the anastomosis. Experience has shown that in time the difficulties in some cases straighten out. Ravdin's<sup>37</sup> observations lead him to believe that the frequently fatal operation for the relief of the alleged obstruction can be generally avoided if the patient is aided by repeated blood transfusions and proper feedings through a jejunostomy. Curphey and Orr also advocate repeated blood transfusions when edema appears in cases of prolonged and serious illness.

As a prophylactic measure in his patients with long-standing, severe malnutrition Ravdin advises several transfusions prior to the operation and also the passage of a Jutte tube down through the gastroenterostomy stoma to the distal jejunum at the time of the operation. Proper nourishment can then be given early in the post-operative period. Eggs and milk are a good source of readily available protein. Yeast concentrate and cod liver oil can also be given through the tube. As solid foods are tolerated, the lean meats, salmon, liver, eggs, milk and cream, the juices of citrous fruits, spinach, lettuce, asparagus, fresh peas, cabbage and tomatoes should be fed. When the patient can ingest these substances, concern about vitamin and protein deficiencies is well past.

In the care of the seriously ill patient, whose relief from disease gives the greatest satisfaction to the physician, the best results are obtained from treatment based on a broad knowledge of every alteration from the normal.

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# THE VALUE OF ROENTGEN RAYS IN THE DIAGNOSIS OF PEPTIC ULCER

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THAT roentgenologic examination is remarkably efficient in the diagnosis of peptic ulcer is universally recognized, but without thoughtful consideration, the numerous ways in which the method contributes to the accuracy of this diagnosis will scarcely be realized. On reflection, however, it becomes apparent that the service rendered by the method is at least sixfold: (1) As a rule, the method can confidently be relied on to disclose any existing ulcer, regardless of the clinical manifestations, which occasionally are quite indecisive. (2) It has a proportionate exclusion value, and will definitely negate the presence of an ulcer, often when clinical data indicate strongly that one is present. (3) It will demonstrate the exact site of peptic ulcers. (4) It will reveal their number, depth and surface extent. (5) It will determine the presence or absence of complications. (6) It will distinguish, or assist materially in distinguishing, ulcers from other lesions and benign from malignant ulcers. All these capabilities of the examination are predicated on the assumption that it will be carried out by an experienced examiner who will apply modern techniques.

The basic roentgenologic sign of peptic ulcer is the excavation produced by the ulcer—the niche or its exaggerated form, the accessory pocket. When the viscus—esophagus, stomach, or duodenum—is filled with barium, the niche, if sufficiently large and favorably situated, appears as a bud-like prominence on the luminal silhouette. If the ulcer is situated so that a satisfactory tangential view is difficult to obtain, as on the posterior or anterior wall, the niche often can be exhibited in the face view as a dense spot by compressing the viscus

and thus thinning out the barium content. However, small niches may escape observation, either in the profile or face view, after the viscus is filled. Hence, at the beginning of the examination the first two or three swallows of the mixture should be distributed over the gastric mucosa by manipulation. If an ulcer is present, however small, the niche will appear as a dense spot and other changes in the mucosal relief that are so often significant in the differential diagnosis will also be well depicted by the thin coating of barium. Subsequently, additional quantities of the mixture may be given in order to complete the anatomic and functional study. By this combined examination of internal relief and marginal contours, all ulcers and other lesions, however minute, that alter the internal topography will almost invariably be disclosed. Necessarily, human fallibility enters into the equation and small ulcers occasionally will not be recognized, but negative errors should not exceed 2 to 3 per cent.

Niches that are more likely to elude discovery are those situated in the esophagus, the juxtapyloric segment of the stomach, and the duodenum. Esophageal ulcers are so rare that the examiner may neglect to look closely for them. The niche of a prepyloric ulcer is hard to exhibit and identify because the affected segment usually is spastically contracted and presents numerous luminal recesses, but in most cases the crater can be found by diligent search. Similar considerations apply to exhibition of the niche of duodenal ulcer, and as bulbar deformity is a fairly safe basis for diagnosis, the examiner has no strong incentive to seek for the niche other than the fact that the niche is



a definite indication that the ulcer is active. In every instance in which the roentgenologic report is negative but the clinician feels nevertheless that a peptic ulcer is present, he should request reexamination with Roentgen rays, for occasionally a regrettable error will thus be prevented.

The reliability of this method of disclosing ulcers is especially notable in cases in which symptoms, physical signs, and laboratory tests are trivial, anomalous, or deceptive. Experienced clinicians are skilful in eliciting and interpreting the clinical history and objective manifestations of peptic ulcer, but frequently such data are inconclusive. On the other hand, many patients recite symptoms typical of ulcer, especially of duodenal ulcer, when none exists, and here the exclusion value of roentgenologic examination is obvious.

The situation, size, and number of ulcers, and the presence or absence of such complications as obstruction, perforation, and hour-glass contraction, are important in the differential diagnosis, in selecting appropriate treatment and in guiding the surgeon if operation is deemed advisable. Clinical judgment concerning some of these factors is often admirably correct, but roentgenologic examination will almost invariably disclose any or all of them or exclude them confidently and furnish convincing proofs.

In the differential diagnosis of peptic ulcer from other lesions, and of benign from malignant ulcer, roentgenologic examination is only slightly less efficient than in other respects, and its abilities and limitations in this regard are perhaps worthy of more detailed consideration.

As previously mentioned, gastric ulcer near the pylorus usually gives rise to marked spastic narrowing of the prepyloric segment and more or less obstruction to the exit of the gastric contents. Unless a niche can definitely be demonstrated, which is often difficult, it may be hard or impossible to distinguish the manifestations from those of prepyloric cancer or syphilis, and sometimes the examiner is

obliged to content himself with the diagnosis of "obstructive lesion at the outlet" without further qualification. At worst this constitutes merely a failure to identify the lesion specifically and is partly offset by the definite disclosure and localization of a pathologic condition. The diagnosis of duodenal ulcer on bulbar deformity without demonstration of a niche is theoretically questionable on the ground that the distortion might be due to carcinoma or to an extraduodenal lesion, but duodenal carcinoma is among the rarest of diseases and bulbar deformity from disease outside the bowel is practically negligible as a cause of error.

Small ulcerating gastric carcinomas in which ulceration is marked and tumefaction slight, often so slight that it is not visible macroscopically after removal, can be distinguished roentgenologically with almost unerring accuracy from simple ulcers, for the tumefaction is visible under compression as a transradiant halo encircling the niche and the adjacent rugae are thinned or effaced. This syndrome is one of the most trustworthy diagnostic indexes at the service of the roentgenologist.

When the presence of a gastric lesion, which is morphologically an ulcer but which is without evidence of a tumefactive component, is established, the question whether it is benign or malignant becomes vitally important. Here the empirical roentgenologic criteria of distinction play the leading rôle, and although not infallible, are always highly significant. Briefly they are as follows:

Benign ulcer commonly is characterized by a smoothly hemispherical niche, sculptured in the gastric wall and projecting beyond the normal confines of the gastric lumen. The crater has a regularly circular, non-elevated margin and the adjacent rugae are accentuated, distorted and often convergent toward it. As a rule, the niche is tender to pressure. An almost constant accompaniment of benign ulcer is gastrospasm in one form or another, such as



diffuse spastic distortion of the antrum, curving of the antrum toward the mid-line, spastic hour-glass contraction of the stomach, and spasticity of the pylorus, causing it to open less frequently and less freely than normal. Often the stomach is hypertonic and peristalsis is active, yet retention occurs frequently.

In contrast, the niche of malignant ulcer is likely to be irregular, both as to base and margin. Rugae in its vicinity often are faint or effaced, seldom or never distorted or convergent. The ulcer is not tender to pressure. Complete absence of any variety of gastrospasm is a common feature. Peristalsis is likely to be sluggish, but the gastric content generally flows freely through the pylorus, and retention is exceptional.

In addition, other indexes have weight in distinguishing benign from malignant ulcer. Many roentgenologists accept the maxim that any ulcer with a diameter exceeding 2.5 cm., which is about that of a quarter dollar coin, most often proves to be malignant. Perforated ulcer with an accessory pocket is almost invariably benign. Ulcers on the posterior or anterior wall, and antral ulcers near the pylorus, seem preponderantly to be malignant. Ulcers on the greater curvature are so commonly malignant that exceptions are considered worthy of special report.

Recently, my clinical colleagues, Comfort and Butsch, undertook to evaluate statistically the clinical indexes commonly applied to the differential diagnosis of benign from malignant small lesions of the stomach, and, in addition, investigated the accuracy of the roentgenologic differential diagnosis. Their study was based on 135 small gastric cancers and 513 benign gastric ulcers, all of which were treated surgically at the clinic in the five-year period 1926 to 1930 inclusive. No lesion in the study was more than 4.4 cm. in diameter. The differential significance of the duration of symptoms, type of history, change in symptoms, gastric acidity, retention, food remnants and occult blood was

determined statistically and expressed in ratios, which, although interesting, are not directly pertinent here. Other findings, however, are well worth repetition. It is notable first of all that, on the basis of incidence alone, a lesion 4.4 cm. or less in diameter has approximately four chances in five of being benign. As to sex, it appeared that if the patient is a man the chance that the lesion is benign is greater than if the patient is a woman. The significance of the size of lesions was not investigated by the authors, but they cited the statistics compiled from a much larger series of cases by Alvarez and MacCarty, who found that an ulcer smaller than a dime (1.5 cm.) has only one chance in fifteen of being malignant, one chance in ten if it is smaller than a quarter (2.5 cm.), an even chance if it is larger than a quarter but smaller than a half dollar (3 cm.), and three chances to one if it is larger than a half dollar.

In their series of cases Comfort and Butsch found that the roentgenologic differential diagnosis was correct in 78 per cent, equivocal ("lesion") in 12 per cent, and incorrect in only 10 per cent. The roentgenologic diagnosis of benign ulcer was confirmed in 93 per cent; in only 7 per cent was the diagnosis contraindicated by the finding of carcinoma. On the other hand, when the roentgenologist made a diagnosis of malignant ulcer, the pathologist found carcinoma in 70 per cent and benign ulcer in 30 per cent of cases. In the cases in which the roentgenologist reported "lesion," carcinoma and benign ulcer were found by the pathologist in approximately equal number.

At the clinic, the clinician in charge of the patient assembles the clinical, roentgenologic, and laboratory data and makes the final diagnosis. Thus occasionally his opinion as to the malignancy of a lesion does not agree with that of the roentgenologist. For example, in this series of cases the clinician changed the diagnosis in nine instances, sometimes with resulting error,

but the changes as a whole netted a slight increase in accuracy.

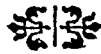
I heartily endorse Comfort and Butsch's statement that when there is doubt as to the benignancy or malignancy of a demonstrable ulcer and operation is regarded with reluctance, medical management may be tried for two or three weeks and checked by roentgenologic reëxamination, but in all such cases the patient should be fully informed of the risk involved.

From these considerations it is clear that the general reliance on roentgenologic examination for the diagnosis of peptic ulcer and for the distinction of benign from malignant ulcer is well warranted. It is equally clear, however, that this reliance should not be supine or exclusive and that neither the roentgenologic method nor any

other should be employed as a substitute for thorough clinical investigation. The closest attainable approach to accuracy in disclosing or excluding peptic ulcer and in predicting the malignancy or benignancy of a revealed lesion is so important that no contributory procedure should be omitted. Clinician and roentgenologist should be mutually helpful and mutually corrective, and when their opinions are at variance, both should recanvass their respective data or reëxamine the patient.

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SHORT-WAVE treatment may be defined as a therapeutic procedure in which the body is included in the circuit of a current that oscillates with a frequency high enough (10,000,000 or more cycles per second) to produce short waves (30 meters in length or less).

From—"Diathermy" by Elkin P. Cumberbatch (William Wood).

# CHOICE OF ANESTHESIA FOR SURGERY OF THE UPPER ABDOMEN\*

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IN making a choice of anesthesia for operations on the upper part of the abdomen the same general considerations apply as for operations in other regions of the body. The prime consideration here as elsewhere should always be the safety and comfort of the patient, but because of certain factors inherent in surgery of this region the application of this general principle requires somewhat different treatment. The anesthetic agent employed should, of course, be as non-toxic and the method used as safe as possible, but, in addition, it is more important here than elsewhere that the anesthesia be such that it produces the best possible operating conditions. This is so because many of the operations in this region, such as gastric resection and operations on the biliary ducts, are difficult and dangerous, and require good exposure for their safe and satisfactory performance. The surgical mortality and morbidity of these operations are comparatively high, far higher than the mortality and morbidity from even the most dangerous anesthetic. It is poor policy to stress unduly the safety of the anesthetic if this be obtained at the expense of operating conditions. It is poor policy, for instance, to save a small fraction of 1 per cent in anesthetic mortality, which is the most that one could hope to do, if this small saving entails an increase in surgical mortality of 1 per cent or more. It is, therefore, important to bear this point constantly in mind in considering the various kinds of anesthesia which may be used in this region.

The gases, nitrous oxide, ethylene, and cyclopropane, are excellent as far as toxicity is concerned, but when used alone, provide such poor operating conditions

that they will seldom constitute the most desirable anesthetics. Nitrous oxide in particular is so weak that for operations in this region the allowable oxygen has to be reduced to the point of actual danger. It is now generally conceded that serious and even fatal cerebral injury not infrequently follows deep nitrous oxide anesthesia.<sup>1,2</sup>

Ether provides a considerable degree of immediate safety and produces fair operating conditions, but has certain definite objections. In order to produce sufficient muscular relaxation for this region, it is necessary to use it in rather high concentration, and in high concentration it has a toxic action on the liver and kidneys, not great, but enough to make its use undesirable particularly in obstructive biliary conditions and in the presence of renal complications. It upsets decidedly the acid-base balance, and produces general post-operative upset, usually accompanied by nausea and vomiting. Unless anesthesia is of extreme depth, muscular relaxation is not complete, and respiration is stimulated so that it may impart considerable motion to the operative field. The relaxed intestines thus bulge into the operative field and hamper the surgeon.

Regional anesthesia is excellent in its freedom from harmful effects and it produces excellent muscular relaxation, but the extent of its field of action is so circumscribed as to limit greatly its usefulness. It is difficult or impossible to anesthetize satisfactorily the entire abdomen except by some special procedure such as epidural or spinal anesthesia, and thus the surgeon is too limited and hampered in his work for operations of such seriousness as are most of those in this region. This anesthesia is,

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however, excellent when the operative field is of such limited extent that it can be readily covered, as in operations such as gastrostomy, jejunostomy, and cholecystostomy. It is especially suitable in such cases because patients having these operations are often in poor general condition, and thus freedom from harmful effects becomes of more than usual importance.

There are various combinations of anesthetics which are widely used by most anesthetists and which are extremely satisfactory in many ways. They are of great variety, but in most of them a combination of one of the gases with ether occupies an important place. One which we have used in many cases with considerable satisfaction consists of avertin, nitrous oxide-ether or cyclopropane-ether by the intratracheal method and with carbon dioxide absorption, and abdominal field block, usually given by the surgeon with the patient under the general anesthesia.

The total effects of these various agents produce sufficient depth without it being necessary to use any one of them in such concentration that harmful effects may result. Thus avertin is used in such dose that post-operative depression or prolonged recovery is not to be expected; nitrous oxide lends its mild help to the general effect without any deprivation of oxygen being necessary, and the abdominal field block produces a local muscular relaxation which makes fairly good operating conditions possible without great depth of anesthesia by ether.

The resulting anesthesia, termed "balanced anesthesia" by Lundy, is of extreme flexibility and is under definite and rapid control. It may be varied at will from a light gas anesthesia to a combined anesthesia of great depth giving extremely good operating conditions even in the upper part of the abdomen. Thus it may be readily adapted to practically any condition which may arise, and for this reason frequently forms the most satisfactory anesthesia for any upper abdominal operation.

Another combination of anesthetics which is very simple, but which we have found effective under certain circumstances, is cyclopropane and vinyl ether. This combination is rapid and powerful in its action. Thus it is suitable for continuing anesthesia when spinal anesthesia wears off before the peritoneum has been closed. Anesthesia can be quickly induced with scarcely any disturbance, and operating conditions are good. A word of warning, however, is necessary. This anesthesia is extremely rapid, powerful, and depressing to respiration. Thus, unless the anesthetist is on his guard and competent to handle these conditions, serious results may ensue. In the hands of an experienced anesthetist, however, it may be of great value.

With the combination of anesthetics which we employ and which I have described, the intratracheal route is used for administration of the inhalation anesthetic. This same route is advantageous when any other inhalation anesthetic is used for operations in the upper part of the abdomen. (1) A free and open airway is assured at all times. (2) This free airway promotes easy, quiet respiration, which is much less disturbing to the operator than the labored breathing of partial obstruction. (3) There is less tendency to straining, probably because the patient is unable to close the glottis even partially, and thus has no resistance against which to strain. (4) The anesthesia is under definite control at all times. If the intratracheal method is not employed, the patient may close the glottis in reflex spasm, especially if the anesthesia is too light when a powerful reflex of the upper abdomen is stimulated. This action causes the anesthetist to lose control of the anesthesia, since he can no longer get either oxygen or anesthetic into the patient until the spasm has relaxed. If, as sometimes happens, the spasm does not readily relax, unsatisfactory operating conditions obtain, and a dangerous condition of anoxemia may soon result. Indeed, it is my opinion that, under certain conditions such as marked cardiac weakness,

a fatality may occur before the spasm relaxes, and I have seen fatal pontine hemorrhage occur in a case of hypertension, probably as a result of the anoxemia caused by laryngeal spasm. Thus it is important to avoid the occurrence of severe laryngeal spasm, and this is effectively done by the use of the intratracheal method.

The use of the carbon dioxide absorption method when any of the gases is employed is also of advantage since breathing is made much more quiet.

Epidural and spinal anesthetics are in reality special forms of regional anesthesia in that they produce their effect by blocking the nerves supplying the region to be operated upon, and to a considerable extent they share with regional anesthesia its freedom from harmful effects. They possess a great advantage over it, however, in that they can readily produce anesthesia over a wide region, particularly over the entire abdomen.

Epidural anesthesia has the advantage over spinal anesthesia that it apparently does not produce those rare neurologic complications which are at present the main drawback to spinal anesthesia. Its disadvantages are that the amount of the anesthetic drug necessary is so large that some toxic systemic effect is often produced; that the induction time is comparatively long, and that satisfactory anesthesia does not invariably result. For these various reasons we have used this method in so few cases that we can say nothing about it from personal experience.

Spinal anesthesia, on the other hand, produces its widespread effects with doses which, when compared with those necessary in regional or epidural anesthesia, are exceedingly small; the induction time, except when dilute solutions are employed, is quite short; and, in the hands of experienced men, satisfactory anesthesia practically invariably results. The combination which it affords of flaccid abdominal wall, quiet breathing, and contracted intestines (this last a feature not produced by general

anesthesia) makes operating conditions far better than those obtainable in any other way. These conditions are especially valuable in operations on the upper part of the abdomen because of the marked technical difficulty so often encountered in this region.

The chief objections to this method in the past have been its danger and its limited time of action. That its record in the past has been bad and that it is still dangerous in the hands of the less experienced is not open to argument. Great progress, however, has been made in the last few years, particularly by the introduction of the two less depressant and longer-acting drugs, pontocaine and nupercaine. Some statistics bearing on total end mortality of anesthesia and operation, which is really the final criterion, will later be presented; but mortality statistics of anesthesia alone are so fallible, depending, as they do, so much on the judgment of the reviewer as to whether death was due to anesthesia or to operation, that no attempt will be made to present any. It is our firm conviction, however, from an experience with spinal anesthesia extending over a period of more than twenty years, that, as it is now used, in the hands of experienced men, its danger is so slight and its advantages in other ways, particularly in producing favorable conditions for operation, are so great, that its use in abdominal surgery, and especially in the difficult procedures performed in the upper part of the abdomen, is more than amply justified.

In any given case, when a choice of anesthesia has to be made for an operation in the upper part of the abdomen, the selection must be made from a list of anesthetics such as I have presented. In making this selection it is necessary to consider many different factors besides the characteristics of the anesthetic itself, factors such as the difficulty, danger, and length of the operation; the characteristics of the patient, whether he is in good or poor general condition, fat or thin; whether or not it will be difficult

to obtain relaxation; the temperament of the surgeon, whether suited to the employment of regional anesthesia or not, and whether he works fast or slowly; and the characteristics of the anesthetist, particularly as to his experience and facility with the anesthetics having the greatest possibilities of danger, such as spinal anesthesia and pure nitrous oxide anesthesia.

It is thus not a simple matter to make the choice in any given instance, and it is not possible to say in general which anesthetic is best for any given type of operation. This can be determined only after a careful consideration of all the various factors.

A few general conclusions can, however, be reached. We believe that in most instances spinal anesthesia is the anesthesia of choice. The importance of the unequalled operating conditions which it produces is very great in this region. Dr. Lahey has kindly allowed me to quote him as follows: "So many upper abdominal operations must be done in deep holes that any motion or spasm of the abdominal muscles greatly interferes with exposure. Removal of stones from the common bile duct or hepatic duct is done at the very bottom of an extremely deep hole. Removal of duodenal ulcers and adherent duodenum for carcinoma of the pylorus is also done in deep holes. Splenectomy, total gastrectomy, and even gastroenterostomy are performed in the upper part of the abdomen where motion and inadequate relaxation greatly interfere with the exposure, and therefore, the accuracy of the procedure. Spinal anesthesia overcomes practically all these defects and makes exposure easier, makes the surrounding viscera quiet, and so makes the operative procedure infinitely safer."

Not only does spinal anesthesia excel in the operating conditions which it produces, but it is also followed by less post-operative upset than is general anesthesia. With general anesthesia these two aspects, good operating conditions and little post-

operative upset, are distinctly antagonistic. The deeper the relaxation and the better the operating conditions the greater is the post-operative upset likely to be. But spinal anesthesia excels not only in producing excellent operating conditions, but also in causing less post-operative upset. Thus it is preferable from two of the most important aspects, and becomes the anesthetic of choice in most instances.

In the actual application of these general principles, however, spinal anesthesia has one serious drawback which greatly limits its use. It is absolutely essential that it be administered and watched by someone competent and well versed in its use. The fact that the anesthetist is competent in other fields is not to the point. He must be competent in this particular field. Lack of appreciation of this point was the main factor which made the mortality from spinal anesthesia little short of a scandal in the period around 1928.

Many surgeons believe that the only important point about spinal anesthesia is the induction period. They administer the anesthetic themselves and then leave the care of the patient to someone who, though perhaps competent in his own field, is not competent in this particular field. These surgeons fail to appreciate the extremely important fact that the patient must be carefully watched during the course of anesthesia, and that appropriate treatment during this period may easily be the deciding factor which means life or death for the patient.

Thus the use of spinal anesthesia in upper abdominal operations should be strictly limited to those instances in which an anesthetist thoroughly competent in this particular field is available. Since, taking the country as a whole, the supply of such men is woefully inadequate, the wide general use of this method at the present time is inadvisable. Therefore, although in a well-equipped hospital, under favorable circumstances, and with a competent anesthetist, spinal anesthesia is usually the anesthesia of choice for

these operations, for this one reason alone it is inadvisable in most instances.

Even when conditions of personnel and equipment are favorable to the use of spinal anesthesia it should by no means be considered an exclusive choice. It should not be employed if there is disease within the spinal canal which might be aggravated by its use, or if there is infection of the back which might contaminate puncture, or in most instances if there is hydrothorax or pregnancy at full term. Most of the contraindications, however, are relative rather than absolute. It is less strongly indicated if the proposed operation is an easy one which may readily be carried out with the patient under another form of anesthesia and if the patient is thin and relaxation and exposure can readily be obtained. It is also less suitable to the frail and weak patient in whom the fall in blood pressure might be unduly depressing. Its greatest field of usefulness will be found when a difficult operation is to be performed on a vigorous, muscular subject in whom it would be difficult otherwise to obtain relaxation.

Our attitude in these respects, however, has recently been somewhat modified. Because of the recent improvements in spinal anesthesia, which have made it less dangerous and less depressing, and because of its lack of post-operative upset as compared with general anesthesia, we have recently used it more frequently in patients who are poor risks, especially if the operation is not prolonged. We have been well pleased with the results, since we feel that the post-operative condition of these patients is much better than it is when general anesthesia has been used.

When spinal anesthesia cannot be used, the anesthesia next in value for upper abdominal operations is some one of the various combinations mentioned, especially if the operation is to be long, for example, resection of the stomach. Since short operations are more uncommon in the upper part of the abdomen than elsewhere in the abdominal field, these com-

binations are especially useful. Before the introduction of nupercaine, we used, with satisfactory results, in all cases of gastric resection, the combination of anesthetics already mentioned, although with the advent of nupercaine we again returned to spinal anesthesia. When no anesthetist is available who is well versed in the administration of spinal anesthesia, or when there is some other contraindication to its use, some one of these combinations makes a very acceptable substitute, which can be used almost routinely with practically all patients, in almost all upper abdominal operations, because it is so flexible that its characteristics can be varied greatly to suit different patients and operations.

When neither spinal anesthesia nor some one of these combinations of anesthetics can be used, ether usually will be the most practical substitute.

Ether alone, however, is seldom the anesthetic of first choice; rather, its use is forced by the necessity of circumstances. Operating conditions resulting from the use of ether are not the best. The tendency toward post-operative vomiting is undesirable in any abdominal operation, but is especially so after operations in the upper part of the abdomen because of the greater tendency there to rupture of the wound. Its toxic action on the liver is a distinct drawback to its use in operations on the biliary tract. Because of its toxic action, because in upper abdominal operations anesthesia must be deeper than in most other procedures and because prolonged deep anesthesia tends to accentuate this toxic action, it is not desirable to employ ether in prolonged operations, such as gastric resection.

Ether, however, does produce fair operating conditions and is of considerable immediate safety. Moreover, it has the important advantage of wide availability, since knowledge of its administration is probably more widespread than that of any other anesthetic. Therefore, although it is not usually the most desirable anes-

thetic, circumstances will often make it the most practical one to employ.

In upper abdominal operations, as elsewhere in the abdomen, regional anesthesia is seldom the anesthetic of choice because of its limited field of action. When the field of operation is not limited, some one of the three anesthetics just mentioned will practically always be preferable. Even when the field of the operation is sufficiently small for the employment of regional anesthesia, exploration of the remainder of the abdomen which is made possible by these other anesthetics usually makes them preferable unless the condition of the patient is such as to make their use inadvisable. When, however, it seems unsafe or inadvisable to use one of these three anesthetics, then regional anesthesia is extremely well fitted for operations in a limited field.

Some one of the above anesthetics should provide at least a reasonably suitable anesthesia for any condition. The various combinations of anesthetics in particular are so flexible that they cover a wide field.

We feel that one of the gases, used alone, should seldom if ever be the anesthetic of choice. Although nitrous oxide is often an excellent anesthetic for operations elsewhere in the body, when a surgical procedure is carried out in the upper part of the abdomen, this anesthetic produces such poor operating conditions that the danger of the surgical procedure is definitely increased. Moreover, anoxemia is so great that the anesthetic is dangerous in itself. Even with cyclopropane, the most suitable of the three, operating conditions are not first rate, so that the addition of other help, such as ordinary ethyl ether or vinyl ether, or the use of abdominal field block always seems worthwhile. Furthermore, without these aids, the necessary concentration of the gas is so high that there is some danger of toxic effects, especially on the heart.<sup>3,4</sup>

In assessing the value of any given method it is always well to consider the final results. With anesthesia, however, it

is extremely difficult to determine what these results are because they are so inextricably interwoven with surgery, which usually is the more potent factor of the two, that it is difficult or impossible to determine the final results of the anesthetic alone. Thus determination of the value of the various kinds of anesthetics becomes largely a matter of observation and opinion. The surgeon and anesthetist must form an opinion from clinical observation. They must determine whether it is better in a particular case, especially in difficult operations on the upper part of the abdomen, and with their particular abilities and limitations, to choose a potent anes-

TABLE I  
MORTALITY OF OPERATIONS ON BILIARY TRACT INCLUDING  
CARCINOMA, COMMON DUCT STONES AND FISTULA,  
UNDER VARIOUS FORMS OF ANESTHESIA\*

Year	Cases	Died	Per Cent		
1925	91	6	6.6		Ether, 5.9 per cent
1926	111	6	5.5		
1927	153	2	1.3	Novocaine, 2.4 per cent	Spinal, 2.6 per cent
1928	123	2	1.6		
1929	139	5	3.6		
1930	138	3	2.2		
1931	118	4	3.4		
1932	118	2	1.7	Metycaine, 2.1 per cent	
1933	119	2	1.7		
1934	143	4	2.8		
1935	145	5	3.5	Pontocaine, 3.4 per cent	
1936	159	3	1.9		
1937	187	8	4.3		

\* Reduction in mortality under spinal as compared with ether anesthesia is probably enough to be significant. Otherwise no significant change is noted.

thetic which will give opportunity for the best and safest surgical procedure, or whether it is wiser to choose some other anesthetic which is perhaps safer in itself but which will inevitably hinder and limit at least to some extent the surgical procedure.

The end results of the combined procedure of anesthesia and operation can, however, be readily determined. They are definite and not a matter of opinion, and



should give at least some idea of the relative value of the different kinds of anesthesia. To be sure, anesthesia and surgery

TABLE II  
MORTALITY OF GASTRIC RESECTIONS FOR ULCER UNDER VARIOUS FORMS OF ANESTHESIA\*

Year	Cases	Died	Per Cent	
1927	3	2	66.6	Novocaine spinal and ether, 25 per cent
1928	6	1	16.7	
1929	4	1	25.0	
1930	5	0	0	
1931	6	2	33.3	
1932	12	3	25.0	Combined anesthetics, in- tratracheal, 15.4 per cent
1933	14	3	21.4	
1934	20	1	5.0	
1935	13	1	7.7	Nupercaine spinal, 8.4 per cent
1936	20	3	15.0	
1937	15	0	0	

\* The term "novocaine spinal and ether" indicates ether often used to piece out a spinal anesthetic of too short duration. There is well marked reduction under each succeeding form of anesthesia. To date (January 13, 1938) thirty consecutive patients have been operated upon without mortality.

TABLE III  
MORTALITY OF GASTRIC RESECTIONS FOR CARCINOMA UNDER VARIOUS FORMS OF ANESTHESIA\*

Year	Cases	Died	Per Cent	
1927	5	2	40.0	Novocaine spinal and ether, 50 per cent
1928	4	2	50.0	
1929	7	2	28.6	
1930	10	5	50.0	
1931	10	7	70.0	
1932	7	0	0	Combined anesthetics, 38 per cent
1933	8	2	25.0	
1934	14	9	64.3	
1935	14	4	28.6	Nupercaine spinal, 21.6 per cent
1936	16	2	12.2	
1937	21	5	23.8	

\* The term "novocaine spinal and ether" indicates ether often used to piece out a spinal anesthetic of too short duration. Again a well marked reduction under each succeeding form of anesthesia is evident.

are still interwoven and cannot be separated, but we have two important aspects of the question: (1) definite facts and figures to help us in forming an opinion; and (2) more important, these facts and

figures relate to end results, which is the all essential final criterion.

In Tables I, II and III, are shown mortality statistics for some of the most important operations on the upper part of the abdomen for periods during which some of the various types of anesthesia already mentioned have been used. During these periods the types of anesthesia indicated were not used exclusively, since change to another type was occasionally made when the circumstances of a particular case made this seem advisable. The anesthesia mentioned was, however, the one used most frequently during that particular period.

The term "biliary surgery" includes operations for all conditions affecting the biliary tract, including carcinoma, stones in the common bile duct, and fistula. Little significant change can be seen under the different forms of anesthesia. The main change is the lower mortality under spinal anesthesia as compared with that under ether anesthesia. Although the mortality under spinal anesthesia is less than half that under ether, a definite claim can hardly be made that this reduction is the result of change in anesthesia, although I believe that this change is an important factor. Whether the rise in mortality with pontocaine spinal anesthesia is significant, and, if so, of what, I cannot say, since it appears to be on the borderline. It seems probable, however, that the increase is too small to be significant, since there is a variation under novocaine spinal anesthesia alone from 1.3 to 3.6 per cent, and under pontocaine spinal anesthesia alone from 1.9 to 4.3 per cent in different years. The higher rate under pontocaine is, therefore, very probably caused by chance variations in the number of particularly unfavorable cases in which operation was performed in those years.

In gastric resections, both for ulcer and for carcinoma, a well marked reduction in mortality under each succeeding form of anesthesia is readily apparent. Here again no claim can be made that this change in mortality is caused by the

changes in anesthesia. It is the result of a great many different factors both before, during, and after operation. Those who have performed and witnessed these operations, however, feel sure that the changes in anesthesia have been a factor of considerable importance. That the influence of favorable anesthesia should be greater in gastric resections than in operations on the biliary tract is entirely reasonable since greater technical difficulty is encountered in performing resections than in most cases of biliary operations.

The outstanding objection which has always been urged against spinal anesthesia is its danger. In this series of 1701 cases in which spinal anesthesia was used, one death occurred which could be directly traced to spinal anesthesia. This is a mortality rate of approximately 0.059 per cent. It is our definite feeling from observation in these cases that our surgical mortality rate has been lowered by the employment of spinal anesthesia much more than the 0.059 per cent increase in our anesthesia mortality rate due to this one case. Moreover, this case occurred more than nine years ago, before the advent of the drugs which we now use and at a time when our experience and knowledge of spinal anesthesia were comparatively small. Such a case would be, to put it conservatively, far less likely to occur today.

In looking over this series of figures as a whole, it cannot be said that anything is definitely proved concerning the effect of the various types of anesthesia. The effects of surgery and of anesthesia are too closely commingled to make this possible. These figures are given rather for the sake of completeness than with the idea that they offer proof. It can, however, certainly be said that they are consistent with the opinions we have formed. After all is said and done, in circumstances such as these, unless statistics indicate something definitely to the contrary, we must rely on the opinions formed in carrying out these operations over a period of years under these various forms of anesthesia.

## SUMMARY

For operations in the upper part of the abdomen, as elsewhere in the body, no one type of anesthesia should be used routinely. In each case the agent and method should be selected which are best adapted to the particular conditions.

In most instances spinal anesthesia with pontocaine or nupercaine is most satisfactory. An anesthetist well skilled in administration and management of this anesthesia is absolutely essential.

When a skilled anesthetist is not available, one of the various combinations of anesthetics, usually having gas-ether, given by the intratracheal route, as its principal constituent, is very satisfactory. When no experienced anesthetist is available, ether is of great value, since it is widely available, is of considerable immediate safety, and produces reasonable operating conditions.

Regional anesthesia is usually unsatisfactory because of its limited field, but when patients are in poor condition it becomes the best possible choice for operations such as gastrostomy and cholecystostomy.

The gases, used alone, are too weak to be at all satisfactory. Of the gases, cyclopropane is much the best. Nitrous oxide carries with it distinct possibilities of danger because of the poor operating conditions which it produces and because exclusion of oxygen may be carried too far.

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# CANCER OF THE STOMACH\*

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CANCER of the stomach is responsible for more deaths than cancer of any other organ in the body. Eusterman, of the Mayo Clinic, estimates that every year there are about 38,000 deaths from gastric cancer.

The treatment of cancer of the stomach usually admits of no therapy but excision, although in the rare cases of lymphosarcoma irradiation is often beneficial. Even then, however, operation should be done either before or after the x-ray treatment. Carcinoma of the stomach if taken in the early stages, can usually be cured by excision. The difficulty lies in making a diagnosis in an early stage, since the technique of the excision itself is fairly well standardized. However, unless we can recognize the disease almost in its incipency and operate immediately, there is but little chance for improvement in the mortality rate of gastric cancer. There seems to be some slight hope that the campaigns for recognizing early cancer are beginning to bear fruit, since the death rate from cancer of the stomach and duodenum, which in 1930 was 21.4 per 100,000 population, has dropped ever so slightly to 21.1 per 100,000 in 1933. This, of course, is too slender a change to breed much enthusiasm, but as there has heretofore been a steady increase in the death rate from this disease, even this slight reversal gives some encouragement.

The early recognition of cancer of the stomach depends much upon the location of the disease. The majority of these cancers arise in the right half of the stomach where early excision should be effective. The occasional cancer in the cardiac portion is difficult to recognize

unless it is discovered by routine or incidental examination. The physiologists have shown that the regions of the stomach along the greater curvature and the cardiac end are practically "silent" so far as symptoms are concerned, unless there is hemorrhage, perforation or obstruction. I have seen a large cancer of the stomach arising from the cardiac region that apparently produced no symptoms whatever until it was of a sufficient size to obstruct the opening of the esophagus. Such cases, fortunately, are rare.

The lesser curvature of the stomach is the physiologically active part. Alvarez, Klein and others have shown that here the beginnings of peristalsis originate, but they are too feeble to be demonstrated roentgenologically. They can, however, be observed in experimental animals under direct inspection. It is only when these impulses reach the middle of the body of the stomach that they are roentgenologically demonstrable.

Cancer that produces obstruction at the pyloric portion of the stomach, or that invades the physiologically active lesser curvature, is recognized much earlier than when it arises along the greater curvature or in the cardiac portion. A primary lesion along the greater curvature is almost always malignant.

The relationship of peptic ulcer to cancer of the stomach is a much mooted point. Practically all pathologists acknowledge that a certain percentage of gastric peptic ulcers becomes cancerous, but just what the percentage is has not been definitely determined. The originally high ratio claimed by MacCarty of the Mayo Clinic is not now generally accepted. Hugh Cabot and

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George Adie<sup>2</sup> noted a careful study by the late Professor Warthin of fifty-six cases of cancer of the stomach in which five showed undoubted evidence of having originated from peptic ulcer. In the discussion Dr. W. J. Mayo reported von Eiselsberg of Vienna as stating that "30 per cent of all ulcers of the pyloric end of the stomach which he was able to resect proved to be undergoing cancerous degeneration," and that Finsterer, in a recent communication, "had said that 26 per cent of gastric ulcers, in all parts of the stomach, have proved to be undergoing cancerous degeneration." Some pathologists believe that many gastric cancers which seem to have arisen from peptic ulcers were cancerous from the beginning. Clinically this distinction is of no great importance if it be borne in mind that even a small lesion in the stomach may be malignant and its nature cannot always be determined except by the microscope.

That polyps of the stomach frequently become cancerous has been recently emphasized. Thus, Miller, Eliason and Wright<sup>5</sup> described eight of their own cases in which apparently benign gastric polyps showed carcinomatous degeneration. They found that in 35 per cent of all the gastric polyps they studied there was a cancerous change at the base of the polyp. Benedict and Allen<sup>1</sup> reviewed the literature and reported seventeen cases of gastric polyps at the Massachusetts General Hospital. Seven of these polyps showed malignant degeneration, with a percentage of 41.2 per cent of malignancy in tumors of the stomach that were supposedly benign, but which gave sufficient symptoms to demand exploration and subsequent removal. In such cases they find that gastric analysis shows rather low acidity and even achlorhydria. There is also a great tendency for these polyps to bleed.

The clinical symptoms and signs of cancer of the stomach vary greatly. There is usually a distinctly lower ratio of free hydrochloric acid in the gastric juice, and in many cases there is complete achlor-

hydria. There is also a tendency toward lower free hydrochloric acid in gastric peptic ulcers than in duodenal peptic ulcers. There are exceptions, however, to the low free acid in cancer of the stomach, as I have had two patients, one with small round cell carcinoma of the stomach and another with advanced adenocarcinoma, in both of whom there was very high acidity.

The incidence of hemorrhage from cancer of the stomach has been greatly exaggerated. The so-called coffee-ground vomit may occur in a late stage, but blood is far more frequently found in the gastric juice or by examination of the stools in peptic ulcer than in cancer. The "string" test for blood may, however, more often detect blood in cancer of the stomach than the analysis of the gastric contents.

It is essential to get away from the textbook descriptions of cancer of the stomach. Virchow's glands, enlarged lymph-nodes at the root of the neck, especially on the left side, indicate an advanced and hopeless stage of cancer of the stomach. Cachexia and a palpable tumor are also late stages, though occasionally a palpable tumor indicates a large fungating mass of low malignancy which bleeds freely, causing anemia, but which may be successfully removed by operation.

E. H. Gaither<sup>4</sup> has called attention to the fact that many statements in the textbooks are not only inaccurate, but may be misleading and actually prevent an early diagnosis. Cancer of the stomach may be remittent in its symptoms, and early cases of cancer of the stomach will practically always improve under medical treatment. This has been emphasized by Thomas Scholz<sup>7</sup> of New York, who reported two cases diagnosed roentgenologically as cancer, one two and a half years and the other three and a half years before they came to an operation. At operation the lesions were too extensive for resection, but the patients were apparently in good health when the diagnosis was first made. Because of the apparent well-being and the improvement of each patient for a while

under medical treatment, the patient and the attending physician did not accept the diagnosis at a time when the lesion was operable.

Gaither<sup>4</sup> discusses the symptoms of gastric cancer as follows: "(a) Local gastric symptoms, loss of appetite, cardialgia, eructation, pyrosis, nausea, vomiting, pain, distention, and variable types of discomfort are no worse in beginning carcinoma than in other gastric disease. (b) A latent stage is possible, during which time the process advances very slowly, with an utter absence of symptoms. (c) A general marasmus, or a variable anemia, may occur, with the gastric symptoms so wholly in abeyance as to be quite unrecognizable. (d) A beginning carcinoma may progress without definite symptoms; again, it is marked by ulcer symptoms, or symptoms of chronic gastric catarrh."

Pain is often given as a symptom of cancer of the stomach. Occasionally pain may come rather early, and may vary from a moderate discomfort to a sharp cramp-like pain. The pain is usually in the epigastrium, but may be in the back or loin. When in the back it suggests a metastasis in probably a later stage of the disease. Pain is not infrequently relieved by food, as hunger pain in peptic ulcer, or it may be continuous. A history of intermittent pain that later becomes more constant has often been assumed to be indicative of cancer. This condition, however, may arise from a peptic ulcer which has slowly perforated and the adhesions around it give a constant pain. Anorexia is common, but it is not present in all cases. The appetite in the early stages may be variable, and under medical treatment the patient may actually gain in weight. Usually vomiting does not occur until the later stages of the disease, when there is partial obstruction. Loss of weight is frequently manifest, though it may be a late symptom. Anemia may also occur late, though should the cancerous mass be fungating, anemia may appear earlier, particularly if there is a bleeding polyp.

*In early gastric cancer all symptoms may vanish for a while under medical treatment.*

The physical examination may show a mass or an indefinite sense of resistance in the epigastrium.

By all odds the most important means of diagnosis of cancer of the stomach is the x-ray, but this should be undertaken by a roentgenologist well trained in work on the gastrointestinal tract. When a stage has been reached that can be easily demonstrated roentgenologically the disease is already well on its way. Newer methods of examination, observation of the rugae and of the absence of local peristalsis, give promise of an earlier roentgenologic diagnosis.

The most important factor in detecting cancer of the stomach in the early stage is being suspicious of cancer. Cancer of the stomach occurs more frequently in men than in women, though in our experience the ratio is not so great as has been reported from some clinics.

Any patient, particularly a man, over thirty-five years of age who has symptoms of indigestion or stomach trouble, should be seriously considered by the physician who first sees the patient. If the cause of the indigestion cannot be determined, and if it does not respond to treatment after a few weeks, the patient should be examined by a competent roentgenologist. If the lesion is in the duodenum it may be medically treated indefinitely unless there is perforation, bleeding or obstruction. If it is in the stomach it is far more serious so far as cancer is concerned. If it appears to be a peptic ulcer, it may be treated medically for a few weeks, after which time another roentgenologic examination should be made and the patient checked up clinically. If there is a marked tendency to heal, the medical treatment may be continued, but if not, a partial gastrectomy should be done. In cases roentgenologically suspicious of carcinoma at the first examination there should be no delay in operation. It must be borne in mind that occasionally

gastric cancer exists along with a duodenal peptic ulcer.

With the modern technique of partial gastrectomy in the early stages of cancer or ulcer of the stomach the mortality rate from the operation in proper hands is low. It is unfair to charge the high mortality of gastrectomy that necessarily occurs in advanced cancer to partial gastrectomies for ulcer or for early cancer. A benign peptic ulcer of the stomach that demands operation should be treated by partial gastrectomy as though it were malignant. It is well known that a v-shaped excision along the lesser curvature is not only inadequate if the growth is malignant, but gives more unsatisfactory eventual results so far as the function of the stomach is concerned than a partial gastrectomy in which the distal half or two-thirds of the stomach is removed. Practically the same operation should be done for gastric ulcer as for gastric cancer.

The preliminary treatment before operation is extremely important. Gastric lavage should be done several times a day. If the patient is dehydrated, he should be given intravenously 5 per cent dextrose in Ringer's solution, about 2,000 to 3,000 c.c. a day. The solution should be given slowly, however, and if it tends to elevate the blood pressure the rate should be decreased. If there is marked anemia, a transfusion of blood is indicated. The importance of pre-operative treatment for cancer of the stomach cannot be over-emphasized. Gastric lavage should be done with dilute hydrochloric acid, about 0.25 to 0.5 per cent. The patient is encouraged to drink this solution, sweetened to make it more palatable, as a physiologic antiseptic, and in ulcers or fungating masses it is very helpful in preventing peritonitis.

If the patient is over sixty years of age, we prefer a local anesthetic after the general method of Finsterer, giving the patient a full dose of morphine or of hyoscine, morphine and cactin one-half hour before the operation. After making an incision and examining for metastases, a

thorough infiltration with novocaine solution, 0.5 per cent, with a few drops of adrenalin solution to the ounce of novocaine solution, is made under the posterior peritoneum around the head of the pancreas and the vena cava. If the patient is thin, this method is usually satisfactory; if it is not, a general anesthetic, preferably ethylene, should be given. At the beginning of the operation an intravenous cannula is inserted and a small flow of 5 per cent dextrose in Ringer's solution is begun. If the blood pressure falls during the operation the flow can be increased. Frequently the blood pressure will rise, and it may be necessary to reduce the flow to a minimum of 50 or 75 c.c. an hour or even to discontinue it.

The technique that I have been using for about fourteen years is a modification of the Billroth I operation, in which the stump of the stomach is united to the stump of the duodenum in such a way that the upper border of the stomach is fixed to the upper border of the duodenum. The duodenum is flared open and occasionally an end-to-end anastomosis can be made if the stomach is not large. Usually, however, there is a redundancy at the lower portion of the stump of the stomach which is readily folded in. This gives a physiologic readjustment of the gastrointestinal tract, and it is applicable in many cases. The stump of the stomach can frequently be mobilized by inserting the hand under it and loosening adhesions, as well as by dividing the gastric artery. It may thus be brought over with little or no tension. If, however, this cannot be done, a modification of the Billroth II method, preferably the Hofmeister, is employed. The stump of the duodenum is closed, the upper portion of the stump of the stomach is sutured, and the lower portion united to the jejunum after the manner of a gastroenterostomy.

The danger of a jejunal ulcer after a Billroth II type of operation for cancer of the stomach is not entirely obviated by the fact that the gastric acidity is low at

the time of operation. After removal of the cancer the gastric secretion may return to normal. Fordyce B. St. John<sup>6</sup> has reported a case in which a Billroth II operation was done for gastric cancer and the patient died later from perforation of a jejunal ulcer.

In a few instances a total gastrectomy is indicated, but such cases are unusual. The operation is followed by a high mortality rate, but there is occasionally a definite indication for it. When this exists, the jejunum is united to the stump of the esophagus end-to-side. Instead of closing the end of the duodenum, it may be sutured end-to-side to the right limb of the loop of the jejunum. Farther down there should be an entero-anastomosis between the two limbs of the loop of jejunum just below the transverse colon, the jejunum having been brought up in front of the transverse colon. Still farther down a mushroom catheter should be inserted for feeding into the jejunum after the method of Hendon.

In the after treatment it is important to give rest to the healing tissues, and at the same time to supply the patient with water, electrolytes and some calories. If a total gastrectomy is done, or if there appears to be a probability of infection, the latest type of the Steinberg coli-bactragen should be placed into the peritoneal cavity at the time of operation. This undoubtedly produces a marked local resistance and calls forth active phagocytic cells from the peritoneum.

Intravenous dextrose in Ringer's solution must be used with caution. If the patients are inclined to be sclerotic and the intravenous solution tends to put up the blood pressure, hypodermoclysis of salt solution is preferable. Coller<sup>3</sup> has well called attention to the dehydration following any operation, and the necessity for treating this condition.

A Jutte or Levine tube is placed in the stomach and continuous or intermittent suction is maintained for two or three days. This relieves the pressure on the

sutures and reduces gas formation. With the tube open and occasional suction, water may be given by mouth freely, because it runs out through the tube and will not distend the stomach. This affords the patient considerable psychologic relief.

Morphine or some form of opiate should be administered freely enough to relieve pain. Records should be kept of all of the intake into the stomach and the drainage from the Jutte tube, and when the stomach begins to empty, usually about the third or fourth day, a small amount of liquid nourishment, preferably oatmeal gruel or some carbohydrate, is given. Fruit juices are not so acceptable as carbohydrates at first. The Jutte tube is removed about the third or fourth day, but not infrequently after feeding is begun it will be necessary to reinsert it for a day or two.

#### CONCLUSION

With early diagnosis many patients with gastric cancer can be cured by operation. But even in the later stages some cancers of the stomach may occasionally be cured and often relieved if there is careful pre-operative and post-operative treatment and skilful application of operative technique.

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# TOTAL GASTRECTOMY FOR CARCINOMA OF THE STOMACH\*

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THE surgeon is frequently confronted with patients suffering from carcinoma of the stomach. These lesions may be diagnosed quite early, particularly those near the pylorus, since symptoms are largely dependent on the amount of obstruction present. Holmes and Hampton<sup>1</sup> have pointed out that any ulceration in the immediate prepyloric region may be looked upon as neoplastic until proved otherwise. The success achieved in this favorable group has offset to some extent the mortality associated with more extensive resections for growths previously looked upon as inoperable. Parsons<sup>2</sup> has found that 20 per cent of patients surviving partial gastrectomy for cancer at the Massachusetts General Hospital are living and apparently free from disease from five to nine and a half years after operation. With the advent of better pre-operative preparation, anesthesia, and surgical technique, there has been a definite trend to more radical surgery in this field.

Total gastrectomy has been of interest to surgeons since the beginning of gastric surgery and as early as 1878 we find reported the experiments carried out in Czerny's clinic by Kaiser,<sup>3</sup> who found that dogs lived happily and in good health for as long as five years after subtotal gastrectomy. This work was of great interest not only to the clinician but to the physiologist as well. There was at this time considerable doubt that an animal could live without any gastric tissue at all. Apparently with this went some argument as to exact definition of total gastrectomy: there was some feeling that if all the stomach between the

cardia and pylorus were removed, the result might be considered a total extirpation. Finally, however, the true definition became evident. We are now agreed that only where the esophagus above the cardia, and the duodenum below the pylorus have been removed with the intervening stomach, is there a true total gastrectomy.

The first record of this operation on a human being was made by Conner<sup>4</sup> in 1884. His patient was said to have been moribund at the time and died of shock just after the procedure had been finished. No other reports are available until 1897, when Schlatter<sup>5</sup> successfully extirpated the entire stomach for cancer in a woman aged 56. He united the jejunum to the esophagus and the patient lived approximately fourteen months after which she died of recurrence of the carcinoma. Following this famous case there was renewed interest in the operation and gradually there have appeared in the literature a good many case reports. Without doubt, many such operations which were carried out, have never been reported.

In 1927 and 1929, Finney and Reinhoff<sup>6,7</sup> carefully collected the subtotal and total gastrectomies on record at this time, called attention to the correct definition of the operation, and gave a full report on the historical data and factors favoring a successful outcome. They reported five total gastrectomies of their own and collected sixty-two additional cases that they felt to be authentic. They pointed out that a small remnant of normal stomach at the cardia, to be used in the anastomosis to the jejunum, greatly lowered the hazard,

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but that these cases should be considered as subtotal and not total resections. The mortality in the collected series of these

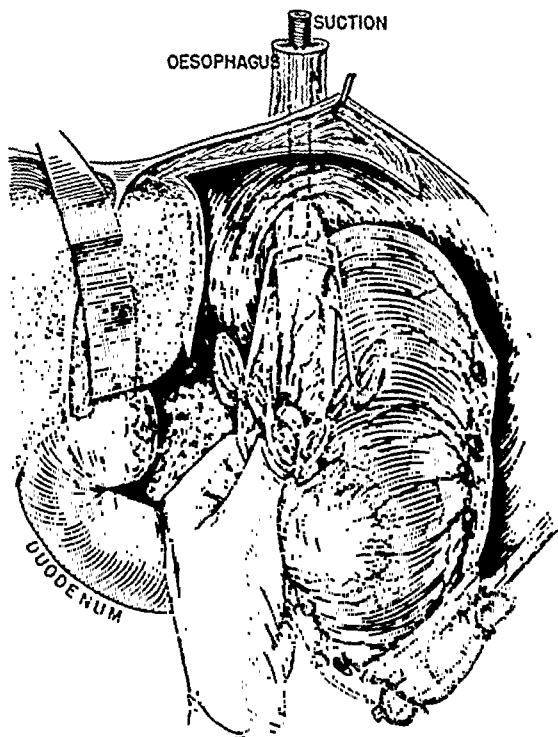


FIG. 1. Schematic drawing illustrating the exposure of the lower end of the esophagus. Note that Levine tube has been withdrawn from the stomach sufficiently to allow the tip to rest in the lower esophagus. The left lobe of the liver has been detached from the diaphragm and held out of the way by a flat retractor.

two groups was approximately 25 per cent for the subtotal and 50 per cent for the total gastrectomies. Also, they emphasized that an anastomosis between the esophagus and the jejunum carried a lower mortality than esophagoduodenostomy. Peritonitis had been responsible for 58 per cent and shock for 22 per cent of the deaths. The patient living the longest in their group survived four and a half years.

In 1933, Roeder<sup>8</sup> reported three cases of his own and collected all the authentic reports since Finney and Reinhoff's publications, thus bringing the total number of complete gastrectomies reported up to eighty-eight. To him must be given the credit for one important step in the operative technique, as he suggested anchoring the jejunum to the diaphragm around the

anastomosis. Since his publication there have been sporadic case reports, but without doubt the operation has become more or less commonplace and it would be difficult to estimate accurately the number of patients subjected to this procedure in the past few years.

During the decade from 1926 to 1936 there have been 713 patients with carcinoma of the stomach admitted to the Massachusetts General Hospital. Of these, 254 were not operated upon, but 28, or 11 per cent, died in the hospital. The majority of these were deemed inoperable after physical examination and Roentgen ray studies, some after peritoneoscopy by Dr. Benedict.<sup>9</sup> A considerable number were offered exploration but refused it. One hundred and sixty patients were subjected to exploration only because studies failed to reveal positive evidence of their unamenable situation. Thirty, or 18 per cent of these, succumbed before convalescence had progressed sufficiently for disposal.

One hundred and five of the 713 had palliative operations, the majority of these being gastroenterostomy. However a considerable number had transections of the stomach proximal to a fixed growth and a posterior Polya anastomosis, with the distal segment of the cut edge of the stomach turned in, leaving the disease excluded. The mortality in the palliative group was 35 per cent.

In 176 cases, partial gastrectomy was done. These operations included all partial resections from excision of the antrum to subtotal gastrectomy. In a few of these an involved segment of transverse colon or pancreas was included in the resection. The mortality in this group was 33 per cent. End result studies will be published on the survivors by Parsons and Welch.

In this past decade, sixteen total gastrectomies have been done in this hospital; five patients were operated upon by me, and in the remaining eleven cases eight other members of the surgical staff participated. Fourteen of these patients had cancer of the stomach, one had lympho-

blastoma superimposed on an old ulcer for which gastroenterostomy had been previously done, and the remaining patient had a large benign ulcer that was thought to be cancer at the time of operation. Eight, or exactly half, of these patients survived the operation and left the hospital in a comfortable state of health. Five are still living at the time of this report, but two of them are believed to have had recurrences nine months and three years respectively after operation. Two are believed to be free of recurrence fourteen months and four and a half years respectively after operation. The ulcer patient is thought to be well although she cannot be traced at this time. The patient living the longest time so far had a highly malignant adenocarcinoma with metastases to the regional lymphnodes.

An analysis of the operative technique employed on these cases, a study of the literature, and various suggestions that seem applicable have brought about a possible standardization of the operative technique for total gastrectomy that we believe may be carried out in suitable cases with reasonable expectation of immediate success. It seems likely that an occasional five-year cure may be obtained, and in all cases we have the satisfaction of having offered these otherwise hopeless individuals a comfortable respite that is well worthwhile.

The type of anastomosis in relationship to mortality in our group is suggestive. Three patients had *esophagoduodenostomy* and all died. The tendency for such a suture line to separate and produce a fatal peritonitis was recognized by Finney and Reinhoff. Eight patients were operated upon in the manner which we will describe in detail below with only two operative deaths. One of them was from peritonitis and pulmonary infection and the other was from lobar pneumonia seven days after operation. The latter case had involvement of the transverse colon and pancreas, necessitating the removal of the whole stomach, a section of the transverse colon,

the spleen, and two-thirds of the pancreas *en bloc*. A detailed report of this case record has been made.<sup>10</sup>

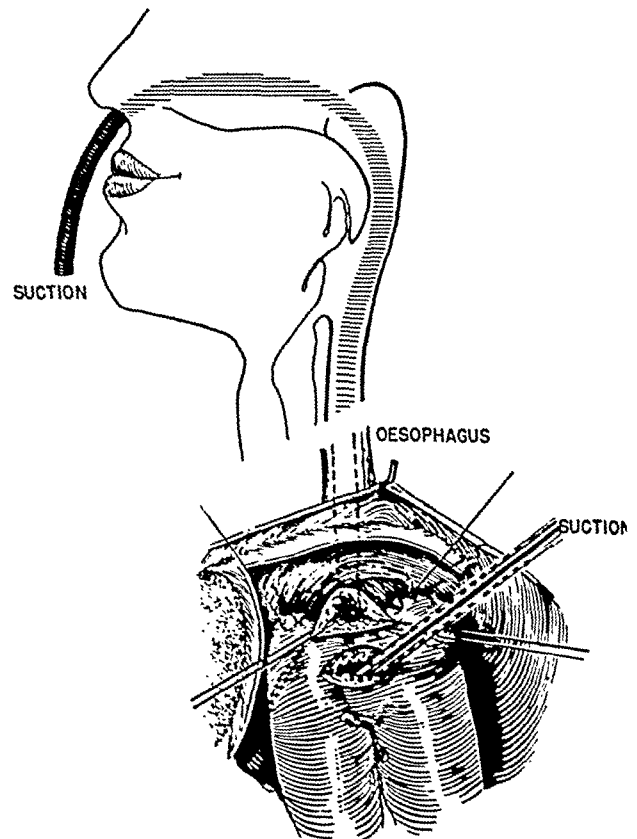


FIG. 2. Schematic drawing to emphasize suction from the Levine tube while the lower end of the esophagus is open. The jejunum has been securely sutured to the diaphragm in a semicircle posterior to the esophagus. The apex of the jejunum is now opened and a suction tip keeps the field of operation clean.

#### OPERATIVE TECHNIQUE

Figures 1 to 4 illustrate the method we feel at present to be a logical procedure. We think the patient will withstand operation better if he is kept in the hospital several days for rest and the establishment of fluid and salt balance. During this time, blood transfusions, glucose, and cevitic acid are administered. With the patient at his best, the operation is planned so that time is no factor.

The anesthesia can be local to the abdominal wall with splanchnic block, usually supplemented with nitrous oxide, oxygen and ether in a closed machine. A well-given intratracheal anesthesia of the above mixture is ideal from the surgeon's standpoint and with certain types of patients, particularly those with deep anterior-posterior proportions, it may be best to use this from

the onset. A Levine tube is introduced into the stomach before the anesthesia is started.

gastro-epiploic vessels are included with as much of the omentum as appears necessary to include the nodes involved.

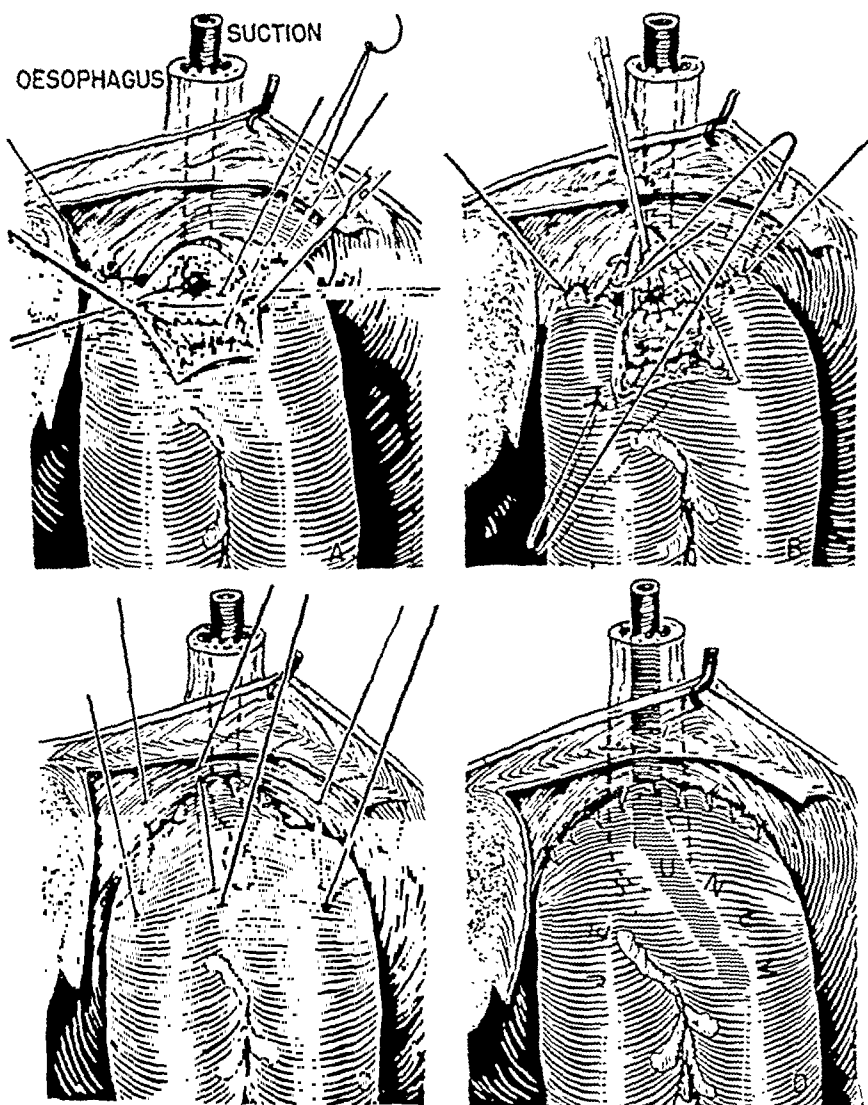


FIG. 3. Schematic drawings. A and B, illustrating a careful approximation of the open end of the esophagus to all layers of the jejunum. These sutures are carried completely around the stoma inverting the mucous edges. C and D, the anterior wall of the jejunum is approximated to the diaphragm, completing the original circle of fixation sutures.

A long left rectus incision carried well up to the zyphocostal angle gives adequate exposure. The duodenum is first freed and severed and the distal segment infolded with two rows of zero chromic catgut on atraumatic needles. Later a bit of attached fat with its blood supply intact is fixed over this structure. The stomach is then freed on both curvatures, starting the dissection at the least adherent area. The

Care must be used to expose and identify the middle colic vessels which are often somewhat adherent to the posterior antrum. There is a constant peritoneal fold attached to this part of the stomach which separates it from the lesser peritoneal cavity. Due to this attachment the middle colic vessels have been inadvertently included in ligatures. If this accident should occur and remain uncorrected, an ischemic

necrosis of the colon will take place with a resulting fatal peritonitis. Also, this fold interferes with the estimation of pancreatic

tions, but somewhat also from the direction of the extension of the disease.

After the curvatures are well freed, the

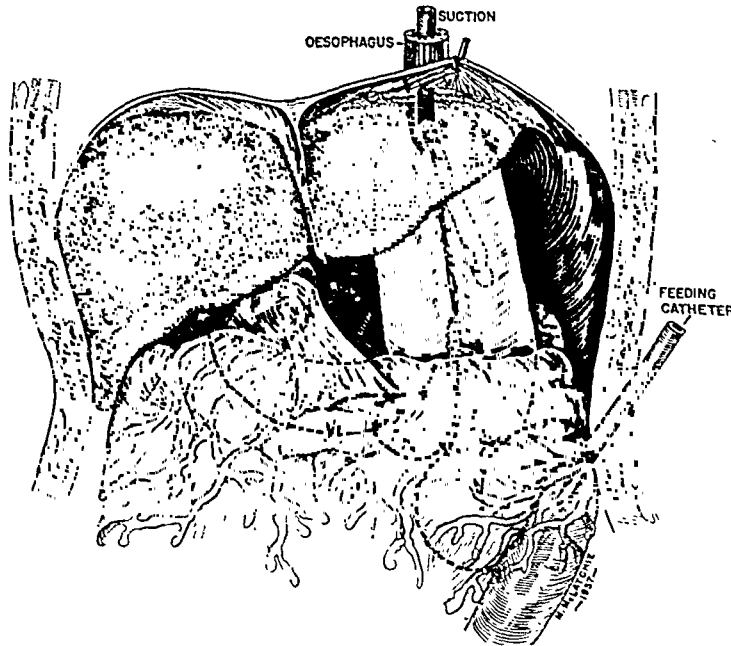


FIG. 4. Schematic drawing illustrating the Levine tube brought down through the esophagojejunostomy stoma into the distal limb of jejunum. The left lobe of the liver has been reattached to the diaphragm. An enteroenterostomy has been made at a low level between the jejunal limbs. A jejunostomy for feeding has been established.

involvement so that it may be wise at times first to open the lesser peritoneal cavity at a free area along the greater curvature, thus determining the operability from this angle.

In resection for cancer, it is rarely possible to secure the left gastric vessels at their source as one often does in resection for ulcer. Involved nodes can be included in the dissection often if they extend well up to the cardia.

We have often observed the ease with which an extensive carcinoma of the stomach, even with a palpable mass, can be extirpated if the anterior-posterior Roentgen ray film shows that most of the organ lies to the left of the spinal column, while those that lie transversely and high in the abdominal cavity are difficult or impossible to remove. This is obvious when we consider the retraction of the lesser curvature into the subhepatic space. This takes place largely from anatomic varia-

left lobe of the liver is detached, as suggested by Turner.<sup>11</sup> Usually this is thin and can be turned down on itself and held out of the way by a retractor. Access is then given to the cardia and lower end of the esophagus. By gentle traction downward and after section of the vagus nerves, from 2 to 6 cm. of the esophagus can be exposed.

At this stage, the Levine tube is withdrawn by the anesthetist, so that its tip rests in the lower esophagus and constant suction is applied. This is a suggestion of Vincent<sup>12</sup> and we have found it very practical as it minimizes soiling from the septic mouth secretions during the anastomosis. This has apparently played a definite rôle in lowering the incidence of peritonitis in our cases.

It is best now to get rid of the specimen as it is always in the way even in a thin, ptotic individual, if one tries to begin the anastomosis before severing the esophagus. In the technically easy cases, clamps can

be put across the esophagus and the structure divided with the cautery. It is always possible to place a clamp on the distal esophagus so that soiling from the stomach can be avoided. If there is insufficient room for a clamp above, guy sutures can be placed on either side and held out of the way while the structure is severed.

The jejunum is now brought up behind the transverse colon so that it rests with no tension against the diaphragm, but without too much slack. This segment of bowel is now fixed to the diaphragm posterior to the cut end of the esophagus by a row of zero chromic catgut or fine silk sutures. This can be made in a semicircle so that eventually the sutures between the jejunum and the diaphragm will be a complete circle around the stoma. The apex of the jejunum is now opened and all layers sutured carefully to the esophagus. During this step, one realizes all too well what a frail and untrustworthy structure constitutes the esophagus. One can therefore obtain considerable satisfaction from having anchored entirely around this anastomosis the jejunum to the more reliable diaphragmatic tissue.

An entero-enterostomy is then accomplished at the lower portion of the two limbs of the jejunal loop. This has a two-fold advantage. It allows the food elements to go down either limb, passing out through this stoma into the distal limb and not back up into the blind alley caused by the closed end of the duodenum. Also, bile and pancreatic juices are carried into the intestine at a more physiologic level.

Finally, a site in the jejunum several inches below this anastomosis is selected where it will lie comfortably in the left flank. A small catheter is introduced into it at this point. Omentum is secured around the catheter, usually by a small penetration through this structure. The catheter is then brought out through a small stab wound. Although the Levine tube is pushed down by the anesthetist and guided into the distal limb of the jejunum it cannot be relied upon for feeding purposes. The patient may inadvertently displace it and

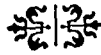
once out it is not safe or often possible to replace it satisfactorily. It does enhance the flow of saliva through the anastomosis and should be kept clear and in place for three or four days. The feedings should be put into the jejunostomy catheter for two weeks. This is best done by a continuous drip apparatus which should be regulated in such a manner that distention is reduced to a minimum. Normal salt solution or sterile water is used for the first forty-eight hours; then broth, dilute milk, egg albumin, etc., are added. As soon as the patient is eliminating gas freely any liquid food can be used.

Stomatitis and diarrhea have complicated the convalescence in some of these cases. We believe these can be eliminated by cevitic acid pre- and post-operatively with a regulation of the type of food introduced through the jejunostomy. High caloric mixtures should be avoided in the early feedings and non-gas-producing liquids used. In one instance, we thought that the addition of dilute hydrochloric acid to the feedings helped to control the diarrhea. The patient is allowed a small amount of water by mouth after the third day. Feedings are begun and well established by this route before the jejunostomy tube is removed. The patient should be discharged on a well-balanced diet and should be urged to eat finely chopped meat and liver. It is surprising to see them gradually extend the time interval between feedings and augment their ability to increase the amount of food taken at one time without distress. The patient in our series who has survived the longest number of years eats three substantial meals a day with only occasional feedings in between. He has maintained his normal weight, blood picture, and works regularly. He complains a bit about having to take most of his food in a finely divided form and gets some discomfort if he eats too rapidly.

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As the mouth cavity is examined commonly by both physicians and dentists, each group should be schooled in the recognition of the so-called "precancerous lesions; first, because the dividing line between the precancerous and the early cancerous lesions is not always distinct clinically and, second, it is well to establish that epidermoid cancer often develops in unhealthy or abnormal epithelium.

From—"Surgical Diseases of the Mouth and Jaws" by Earl Calvin Padgett (Saunders).

# MALIGNANCY IN THE CHRONIC GASTRIC ULCER\*

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WHEN Cruveilhier<sup>1</sup> established gastric ulcer as a pathologic and clinical entity separate from carcinoma, he differentiated it from chronic gastric ulcer by this means. Also certain radiologic features of some ulcers are rather patho-

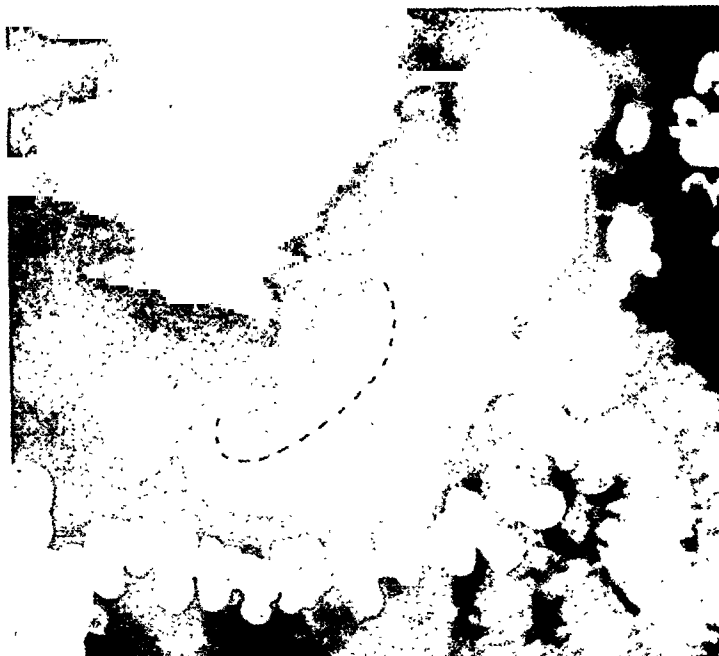


FIG. 1. Meniscus sign. Note the large crescentic encroachment on the lumen of the stomach about the central ulceration. This lesion was a malignant ulcer occurring on the posterior wall of the stomach. The meniscus sign is practically pathognomonic of malignancy and usually has to be obtained with the aid of palpation at fluoroscopy. Dotted line indicates the extent of the meniscus.

cinoma of the stomach, he laid the foundation for our modern conception of these two conditions. He mentioned the occasional presence of both lesions in the same organ, but thought the two conditions could always be differentiated grossly one from the other.

Since then the advent of the roentgenographic examination has enormously assisted us in the clinical diagnosis. The usual types of scirrhus and papillary carcinoma of the stomach are easily

gnomonic. Thus the meniscus formation about an ulcer (Fig. 1) signifies malignancy,<sup>2</sup> while the formation of an accessory pocket by the niche (Fig. 2), is fairly good evidence that the ulcer at least started as a benign one.<sup>3</sup> It was hoped at one time that the size of the ulcer, as revealed roentgenologically, might be a good index of its character.<sup>4</sup> It is true that the majority of ulcers over 2.5 cm. in diameter are malignant, while most of the small ulcers (1 to 1.5 cm. in diameter) prove to be benign.

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However, there are so many exceptions to this general rule (Fig. 3) that it is almost valueless as a guide to therapy

other hand, if all cases of gastric carcinoma with symptomatic or roentgenographic evidence of ulceration were included in the



FIG. 2. An ulcer with an accessory pocket outside the stomach. As a rule such lesions are benign no matter how large the crater, unless definite characteristics of malignancy are present in the stomach wall adjacent to the ulcer. This enormous ulcer proved to be benign.

in the individual case.<sup>5</sup> Other factors, such as the age of the patient, the constancy and duration of symptoms, the location of the ulcer, etc., assist from a statistical basis,<sup>6,7</sup> but are inadequate in the individual instance for making this differentiation.

In the century since Cruveilhier's time, we have learned that there is a lesion with all the characteristics of the benign ulcer which proves nevertheless to be malignant. The exact frequency of this malignant ulcer which cannot be differentiated either by symptoms, by x-ray examination, or at times even by gross examination, will vary considerably in different series, depending partly on the criteria established by the compiler. Thus, if every ulcer in the stomach is considered a potentially malignant lesion, then automatically all lesions which eventually prove to be malignant would be segregated as carcinoma suspects and would never appear in the statistics of a group of chronic gastric ulcers. On the

group, the percentage of such chronic malignant ulcers would be disproportionately high. In the record when the diagnosis eventually proves to be malignancy, the preliminary diagnosis of gastric ulcer is discarded and the case is classified in the diagnostic file as carcinoma of the stomach. Consequently the only method of estimating the percentage of cases, which present themselves as chronic gastric ulcers but eventually prove to be malignant, is by studying the diagnostic data after careful clinical and roentgenographic study but before the final pathologic evidence is known. It is, in our opinion, a conservative estimate that, when the incidence is determined in this manner, 10 to 20 per cent of the chronic ulcers of the stomach without definite criteria of malignancy prove eventually to be or to become malignant.

Whether such ulcers are from the first carcinomatous or whether they represent



a malignant degeneration of a pre-existing benign ulcer has been vigorously debated. This interesting subject has been previously

gastric ulcers there is at present no method of examination, either clinical, chemical or roentgenographic, that will with certainty

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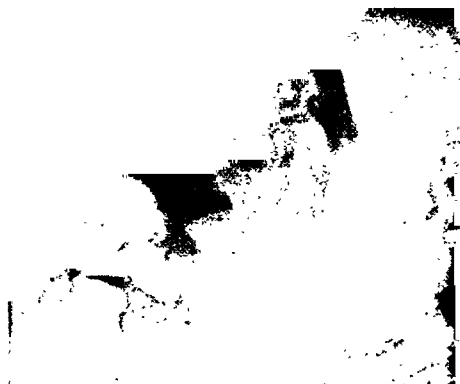


FIG. 3. The size of the ulcer crater is no criterion of its malignancy in the individual case. This ulcer on the lesser curvature of the stomach measured 3.8 cm. in diameter. It was resected and proved benign.

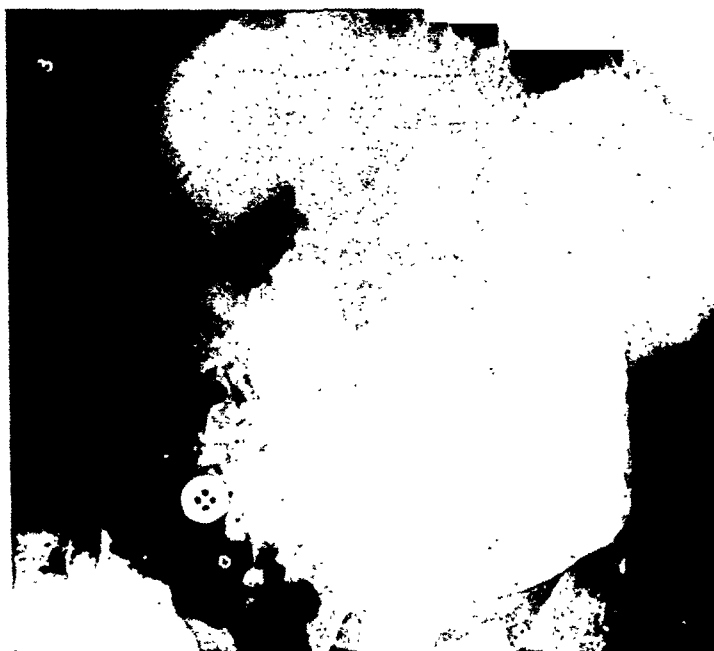


FIG. 4. Gastric ulcer located on the lesser curvature at the incisura angularis. In spite of the immediate complete relief of symptoms by an ambulatory medical regime, the size of the ulcer was not decreased at the end of three weeks. Hence the lesion was treated as carcinoma. (Fig. 5 shows the microscopic picture.)

carefully reviewed by one of us.<sup>8</sup> The controversial aspects of this question have distracted attention from the important clinical fact; in the majority of chronic

distinguish the malignant from the benign lesions. And yet it is extremely important to determine this point to give the advantage of early operation in the malignant

case. One solution of the problem proposed by the surgeon is to operate upon all cases of chronic gastric ulcer. Another method of

acteristic, coming two to three hours after meals and being relieved by soda, though not so much by food. The bouts of pain had re-



FIG. 5. Same case as in Figure 4. Transition in the mucous membrane from relatively normal architecture to definite carcinoma at the edge of the ulcer. ( $\times 100$ .)

handling this situation is to ignore the danger of malignancy. Neither of these plans is acceptable today, the first because it entails unnecessary surgery in many cases, the second because it takes away the patient's best chance for a cure. Its exponents claim for gastroscopy that it is a valuable adjunct in deciding the character of an ulcer. Eventually this direct visual inspection may be very helpful when the ulcer can be seen but it has not yet sufficiently proved itself. The following case illustrates the dilemma of the chronic gastric ulcer and the method we have adopted to meet it.

C. W. A., a 62 year old farmer, was referred to the out-patient department of the Strong Memorial Hospital on January 31, 1934, complaining of attacks of epigastric pain of seven months' duration. The pain was fairly char-

cently become somewhat more frequent and severe. The patient reported that he did not vomit, but was frequently nauseated. He had lost 15 pounds in weight.

On physical examination he appeared rather thin and he had a moderate degree of arteriosclerosis. No masses were palpable in the abdomen, nor was there any tenderness elicited. Examination of the blood and urine proved negative. On gastric analysis, he had no free HCl in the fasting sample, but did have thirty minutes after an alcohol test meal. A stool specimen gave a negative test for occult blood.

On his first visit to the out-patient department a tentative diagnosis of peptic ulcer, unlocalized, was made from the history and while arrangements for gastrointestinal x-ray studies were being completed, he was put upon an ulcer régime (ambulatory smooth). This promptly relieved his pain and made him quite comfortable. The gastrointestinal series showed

a fairly large ulcer niche on the lesser curvature of the stomach just distal to the incisura angularis. (Fig. 4.)

to explain to him the dangers of the situation. With the aid of the brother's persuasion, the patient finally accepted operation which was



FIG. 6. Carcinoma producing an extensive characteristic filling defect along the greater curvature of the stomach. At the time this x-ray was taken, symptoms were relieved by dietary treatment and the patient gained 25 pounds in weight. The diagnosis was verified later by biopsy of metastases.

As soon as the ulcer was localized in the stomach, he was advised to come into the hospital for a period of strict medical régime, but, since he had no pain, he refused to follow this advice. The importance of repeating the x-ray studies in three weeks time was urged upon him, however. This was done on March 28 and no significant change in the size of the filling defect was found although there had been complete relief of symptoms and a gain of 10 pounds in weight. As this failure of the ulcer to decrease in size placed it in the carcinoma-suspect group in spite of the clinical improvement, he was advised to enter the hospital for operation. He refused to accept this advice even on a trial basis. Consequently his brother, a minister, carried him a distance of 400 miles in order

carried out on April 9, 1934. A chronic ulcer was found at the site indicated by the x-ray examination. It was moderately indurated but had no characteristics to distinguish it as a malignant ulcer. On microscopic section, however, there was definite infiltration of the ulcer base with carcinomatous cells. (Fig. 5.) Four years after operation this patient is symptom-free without evidence of recurrence.

Certain features in the above case emphasize facts of great clinical importance. In the first place, the complete disappearance of symptoms with a significant gain in weight when the patient is put on a medical régime is no evidence whatever

that the ulcer is benign. In fact, frequently the malignant gastric lesion will respond in this manner even when it presents unmistakable roentgenologic evidence of its malignancy. Figure 6 shows such a frank carcinoma of the stomach producing a large filling defect of the greater curvature. Yet for three months this patient's symptom of gastric distress was unfortunately controlled by a medical ulcer régime under the care of her local physician while she gained 25 pounds in weight. She was referred for surgery only after symptoms had recurred under treatment, a condition which usually signifies an extension of the malignant process. Dr. Osler frequently called attention to such temporary improvement on the institution of dietary treatment in gastric carcinoma.

In the second place, however, the failure of the ulcer to decrease significantly in size after three weeks treatment places it definitely as a carcinoma-suspect. Jordan and Lahey<sup>9</sup> were the first to emphasize the importance of such a response as a criterion of the nature of the ulcer.

In our clinic, all gastric ulcers are divided within three weeks into two groups on the basis of their behavior on a strict ulcer régime.<sup>10</sup> The first group contains most of the benign ulcers, and is characterized as follows: (1) Ulcer pain diminishes in the first week. (2) All symptoms and occult blood in the stool (if present) disappear within two weeks. (3) *There is a significant decrease in the size of the ulcer niche (at least one-third of its cross-sectional area) within three weeks.* If any of these three conditions is not fulfilled, the ulcer immediately falls into the second or carcinoma-suspect group. This latter contains almost all of the carcinomatous ulcers, together with a minority of benign ulcers, which are particularly recalcitrant to medical treatment (usually due to an adherence of the ulcer base to the pancreas or liver).

As previously emphasized, malignant ulcers not infrequently respond to treatment with symptomatic relief; a few of them will even give roentgenographic

evidence of healing at the end of three weeks. Consequently it cannot be inferred that the ulcers in the first group are all benign ulcers, but only that conservative treatment should be continued. The ulcer, however, should be followed roentgenographically at intervals of four to six weeks until the niche has completely disappeared. Then, if symptoms recur on treatment, or if the ulcer after decreasing in size becomes stationary or particularly if it begins to enlarge, this immediately transfers the case to the second group and prompt operation becomes imperative. The importance of following this rule is illustrated by the following case:

P. W., a 40 year old man with a somewhat vague previous history of ulcer was admitted with a perforation on December 12, 1931. It was thought before the first operation that the ulcer was probably duodenal, but a free perforation 1 cm. in diameter without any unusual induration about it, was found on the lesser curvature of the stomach about 2.5 cm. from the pylorus. This was closed by inversion and the patient had an uninterrupted convalescence with symptomatic relief for about two years. He then had a recurrence of some distress but not sufficient to bring him back to the clinic until about six weeks later when he had a major hemorrhage presenting clinically as melena with a drop in the red count to 3,500,000. In view of the recurrence of symptoms, however, as soon as he had regenerated a fair proportion of the lost blood, operation was carried out on the patient as a carcinoma-suspect. The site of the previous ulcer on the lesser curvature could be identified by two encysted black silk sutures on the peritoneal surface and the lesion was directly contiguous to this scar on the posterior surface of the stomach. Due to the extensive induration of the lesion, it was thought to be a malignant ulcer and microscopic examination proved it to be such. A subtotal gastrectomy was carried out which gave the patient complete relief for two years, after which he developed metastases to the spine. This is the only case that we have had in which free perforation of a non-indurated gastric ulcer has eventuated in a carcinomatous ulcer.

Graham<sup>11</sup> records a most unusual case in which he followed the healing of an ulcer

niche to complete disappearance with the subsequent recurrence of a malignant ulcer at that site. While such extreme examples as these cases are unusual, the recurrence of symptoms from a gastric ulcer while the patient is on an adequate conservative régime is always an ominous sign and at once puts the ulcer in the carcinoma-suspect group.

The final feature, and an extremely important one in the management of these ulcers, is the type of surgery to be employed in the second group, which does not respond with satisfactory healing to the therapeutic test. Many surgeons feel that a local excision of the lesion (usually with gastroenterostomy) is satisfactory. Indeed, this is probably the prevailing opinion, even being held by some leading surgical authorities.<sup>12,13</sup> However, we are convinced both on *a priori* reasoning and on the basis of the experience of ourselves and others that this plan is absolutely wrong if the patient is a fairly good surgical risk. The majority of the benign gastric ulcers by the plan outlined never require surgical intervention, and most of the group selected in this manner by their response to the therapeutic test prove to be malignant. It is impossible to tell at operation in this selected group which will prove to be benign and which malignant. Consequently we feel that the only rational plan is to treat the ulcers of this group at operation exactly as the surgeon would if he knew the pathologic section showed malignancy already at hand. This means, in our opinion, carrying out subtotal gastrectomy, including the lymph gland-bearing areas along the left gastric artery, in the para-duodenal region, and of the gastrocolic omentum. It is known that carcinoma of the stomach often spreads microscopically in the adventitial layers to a greater distance than is removed by the local excision of such an ulcer and of course the latter procedure leaves all the lymph glands intact. This reasoning has been reenforced by our knowledge of several cases where the surgeon, feeling definitely

that the lesion was a benign ulcer, removed it locally with a generous ellipse of the surrounding gastric wall with the all too prompt recurrence of the carcinoma locally.

The exact type of subtotal gastrectomy is a matter of individual preference. We usually use an end-to-side gastroenterostomy with a long jejunal loop brought anterior to the colon and so arranged that the greater curvature of the stomach is attached to the jejunum proximally and the lesser curvature distally. This is the Moynihan modification of the Polya operation and is, in our estimation, ordinarily more desirable for this purpose than the generally adopted Balfour modification because the latter requires an entero-enterostomy between the two limbs of the anastomotic loop while the former does not. While the Moynihan-Polya subtotal gastrectomy is the one we usually use, this choice is modified by the physical circumstances found. When there is a short jejunal mesentery, or a very heavy omental panniculus, the method described by Lahey is frequently adopted rather than bringing the jejunal loop anterior to the colon. In this procedure, the first portion of the duodenum is freed at Treitz ligament and is brought up directly into the lesser peritoneal cavity and the jejunum distal to the anastomosis passes through the transplanted mesocolon as a single segment rather than a loop. There are numerous other methods of reconstruction after subtotal gastrectomy which have recently been well reviewed by Pack.<sup>14</sup> No method which does not provide for careful removal of the lymph gland-bearing areas will, in our estimation, be ultimately acceptable. For this reason, the Billroth I operation and all of its modern modifications are usually to be avoided because they frequently limit the amount of the lesser curvature of the stomach which can be taken and hence prevent the extensive removal of the lymph glands along the left gastric artery. The guiding principle in the choice of the technical method is that the procedure should be the one which the

surgeon would chose if he knew the ulcer to be definitely carcinomatous.

There is one additional word of warning

should be resorted to promptly. Some will indeed prove to be malignant prepyloric gastric ulcers.



FIG. 7. Deformity in the pyloric region. It was impossible to determine whether the pylorus was proximal or distal to the involvement. Consequently this patient had an exploratory laparotomy because of the danger of procrastination in the presence of a prepyloric lesion. A duodenal ulcer was found at operation.

that should be given. Duodenal ulcers are practically never malignant. However, small ulcers just proximal to the pylorus may produce a typical roentgenologic appearance of the usual duodenal ulcer, namely a constant spastic deformity of the duodenal cap, without anything to suggest the localization of the lesion on the gastric side. Prepyloric gastric ulcers, as Holmes first emphasized,<sup>15</sup> have an increased likelihood of malignancy although there is a controversy about the exact incidence.<sup>16</sup> Consequently, if the lesion cannot be proved to be duodenal by the presence of a niche or the visualization of a fleck definitely distal to the pylorus, then the possibility of the lesion being prepyloric rather than postpyloric must be borne in mind. If the lesion is refractory to treatment or if symptoms recur, particularly in the older group of patients, exploratory laparotomy

F. T. F. is an excellent illustration of this mistake in diagnosis. The gastrointestinal roentgenologic examination showed only a persistent irregularity of the cap with tenderness localized over it. The typical ulcer pain during the day quickly cleared up on a Sippy régime and the patient was discharged from the hospital though a residual night distress still remained. On an ambulatory ulcer régime, severe pain recurred in two months and on this account the patient was explored. A small non-indurated, prepyloric ulcer was found. The surgeon who was operating was so sure that this could not be malignant that he carried out local excision with a liberal wedge and a posterior gastroenterostomy. On microscopic examination, the ulcer proved to be malignant. The patient was urged to submit to a subtotal gastrectomy immediately, but completely relieved of her symptoms, she refused, only to return within a year with a large recurrent malignant mass in the epigastrium verified by biopsy.

Sometimes the deformity associated with the lesion makes it impossible to place with certainty the position of the pylorus. Figure 7 illustrates such a situation. If the roentgenologist is in serious doubt whether the lesion is proximal or distal to the pylorus, then it is wiser to carry out exploratory laparotomy than to procrastinate, possibly in the presence of a prepyloric ulcer. Each year there come to our attention one or two cases of prepyloric carcinoma in which the possibility of malignancy was not considered because the lesion was diagnosed as a duodenal ulcer.

#### CONCLUSIONS

1. Any chronic gastric ulcer may be carcinomatous. There is no certain clinical or roentgenologic differentiation between the two conditions.

2. Symptomatic relief on medical treatment is no assurance that the lesion is not malignant.

3. The prompt relief of symptoms, together with a significant decrease in the size of the ulcer niche, is an indication for continuing conservative treatment, but the ulcer must be followed roentgenographically until completely healed.

4. Failure of the ulcer to decrease steadily in size or the return of symptoms while on treatment immediately makes the lesion a carcinoma-suspect.

5. Ulcers just proximal to the pylorus may produce by x-ray only a constant spastic deformity of the duodenal cap and hence be diagnosed duodenal ulcers. It is

important to bear in mind the possibility of malignancy where a supposedly duodenal ulcer is recalcitrant to treatment.

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# MULTIPLE GASTRIC POLYPOSIS\*

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THE term, "polyp," originated by Galen for pedunculated tumors of the nose, refers merely to the form which any growth may assume, and is not indicative of any structural property. In this report, we shall discuss only the essentially benign, multiple epithelial growths, polypoid in structure, which affect the gastric mucosa. The terms, "multiple gastric polyposis" and "diffuse gastric polyposis," even though they inaccurately differentiate the microscopic pathologic structure, fit well the gross picture and have a well grounded connotation in the medical mind.

Although, in this discussion, we are interested primarily in the stomach, we have referred with some frequency to intestinal polyposis. Many writers on alimentary multiple polyposis have reported data on the entire gastrointestinal tract, without segregating that pertaining to the stomach. For this reason, the reader is asked to distinguish carefully between facts pertaining to multiple polyposis of the stomach and those pertaining to multiple polyposis involving the remainder of the alimentary tract. There are many similarities between them, yet there are also important, clear-cut differences.

## INCIDENCE

In their investigation, the authors have included only those cases which had three or more polyps. The rarity of the affection is illustrated by the statistics of Ebstein,<sup>1</sup> who found only ten cases in 600 autopsies; of Balfour,<sup>2</sup> who found only one case in over 69,000 abdominal sections, 8,000 of which were for gastric lesions; and of Carman,<sup>3</sup> who encountered only two cases

in 50,000 roentgenologic examinations of the stomach. In 1926, the authors, their interest aroused by the occurrence of several successive cases within a five-year period, were led to review the subject, and reported a statistical analysis of every available case collected from the literature from 1820, adding five proved personal cases and seven probable cases. For details of this series, the reader is referred to that report.<sup>4</sup>

## ETIOLOGY

What causes these multiple polypoid growths of the gastric mucosa? A great controversy burns over this question. Of the many theories, only two are acceptable. The one, supported by Wechselmann,<sup>5</sup> Rippert and others, claims them to be of congenital origin. It cannot be denied that in multiple polyposis involving the large bowel there is a definite hereditary factor. The condition has been found in twins, in three, four and six brothers and sisters, in a mother and son, and in many members of a family. Wechselmann claims that 50 to 60 per cent have outspoken familial factors. With primary multiple polyposis of the stomach, the incidence of hereditary factors is far different. In the authors' collected series,<sup>4</sup> not one showed an unquestioned positive hereditary influence. The other theory, supported by Menetrier,<sup>6,7</sup> Cornil,<sup>8</sup> Verse<sup>9</sup> and others, maintains that chronic inflammation is the cause. Certain important experimental and clinical facts also strongly support this contention.<sup>10,11,12</sup> The authors are convinced that there are both congenital and inflammatory polyps.

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## PATHOLOGY

Congenital polyps may often be distinguished from inflammatory ones by inspection alone. The congenital ones are usually independent growths, often of considerable height, differentiated into head and stalk, and freely movable on the submucosa. On section the submucosa insinuates itself into the growth to a variable extent as a connective tissue core. The distinct growths are separated by normal mucosa. On the other hand, the inflammatory polyps lack the impression of distinct, well demarcated growths. Usually their margins are defective and merge into the normal tissue; they project only a short distance into the gastric lumen; they are never differentiated into head and stalk; and they rest immobile and broad-based on the submucosa, which never enters the growth as a core. The intervening mucosa as well as the polyp and its base show all the signs of chronic inflammation. A large amount of mucus often overlays the gastric mucosa.

Menetrier (1888)<sup>6,7</sup> first classified multiple gastric polyposis into two types: "*polyadénome polypeux*," consisting of multiple, discrete, usually pedunculated polyps, and "*polyadénome en nappe*," characterized by well-demarcated plaques of closely placed folds of hypertrophic mucous membrane. This classification is still in vogue, despite the fact that Menetrier recognized only an inflammatory origin in all gastric polyps.

On microscopic examination the congenital growths show an adenomatous pattern with a fairly well marked connective tissue stroma, and with little or no inflammatory reaction; the inflammatory polyps show a diffuse increase and enlargement of the gastric glands which show no departure from normal. One of our cases displayed a peculiar teliangetatic formation composed of endothelial spaces filled with blood. A similar extraordinary gastric polyp was described by Monfalcon (1820), the structure of which resembled that of

the corpus cavernosum. This type of teliangetatic growth should be borne in mind in the diagnosis.

The presence of malignant degeneration is by no means always easy to determine. In fact, there is a noteworthy lack of agreement among pathologists regarding the criteria of malignancy. Professor G. Y. Rusk, Chief of the Department of Pathology, Mt. Zion Hospital, diagnosed all of our reported cases on the basis that invasion by atypical glandular elements constitutes the major characteristic of malignancy.

Although no portion of the stomach is exempt, the lower third and the greater curvature are the most frequent sites for multiple polyps. They may vary in size from barely apparent ones to those the size of the fetal head; one case had 400 separate growths.

## SYMPTOMS AND SIGNS

Multiple gastric polyposis may give no symptoms or merely the indefinite symptoms of a usual gastric disorder. Our collected series<sup>4</sup> showed abdominal distress present in 28 per cent; vomiting, anorexia, constipation, diarrhea and weakness, each in about 17 per cent; hematemesis in 8 per cent. It has been claimed that symptoms are produced not by the polyps themselves, but by the associated inflammatory reaction. Certain pedunculated polyps, situated near the pylorus, may prolapse into the duodenum, causing acute obstruction. In one case,<sup>14</sup> such a prolapsed polyp separated from its base and was recovered from the stool.

Symptoms of a severe secondary anemia may be the only complaints. The constant concealed hemorrhage is apt to cause a picture closely simulating pernicious anemia, especially since 90 per cent of cases are associated with achlorhydria. There were no instances of pernicious anemia in our series. Symptoms have been present in certain cases for from fifteen to thirty years without any evidence of malignant degeneration. However, a sud-

den increase in severity of symptoms should warn one of the possible onset of this complication. The essentially benign nature of gastric polyposis is attested to by these long-continued cases.

#### DIAGNOSIS

In 1909, Wegele<sup>15</sup> made the first ante-mortem diagnosis of diffuse gastric polyposis during operation for a gastric lesion incorrectly diagnosed as carcinoma from a piece of tissue recovered through the stomach tube. The total absence of gastric symptoms in many cases, and the fact that symptoms when present are not characteristic, account for the large percentage of cases which defy recognition until post-mortem. Achylia, myxorrhea and gastric hemorrhage should arouse strong suspicion of the presence of this condition.

The roentgenogram is the most important single diagnostic aid; the roentgenologist must be careful to differentiate the lesions from carcinoma, bezoar and lymphosarcoma.<sup>4</sup> In every case in which the roentgenogram was utilized, there was an apparent lesion. Achylia is the next most common laboratory finding, being present in 90 per cent.

Even when full use is made of the x-ray and the laboratory, it is possible to miss the diagnosis. One patient with a long history of gastric disturbances, typical roentgenograms, occult blood in the stool, achlorhydria and myxorrhea, was incorrectly diagnosed by the authors as multiple gastric polyposis and submitted to operation; an extensive hypertrophic gastritis was found, but no polyps. Another case of multiple diffuse gastric polyposis was undiagnosed during life in a hospital where a number of the authors' previous cases were seen, despite a gastric roentgenologic examination by a competent roentgenologist. In the roentgenologic examination the older method of filling was utilized. Newer methods of roentgenologic diagnosis, such as the use of thick opaque media and compression, would tend to eliminate

such errors. More recently one of us, in making an ante-mortem diagnosis of diffuse colonic polyposis, entirely missed a coincident symptomless diffuse gastric polyposis which was found at autopsy. Only 7 per cent of our gastric cases had polyps in other portions of the alimentary tract. It is possible that if all cases of *intestinal* polyposis were investigated as to the presence of coincident multiple polyposis of the *stomach*, the percentage of coincident involvement might be greater.

Since Schindler (1922)<sup>16</sup> reported the first case of multiple gastric polyposis diagnosed by gastroscopy, the use of this method has gradually gained favor in the diagnosis of obscure gastric conditions and has recently received a strong impetus for its more frequent use. Had gastroscopy been performed by an experienced gastroscopist, it is probable that our case of hypertrophic gastritis would have been correctly diagnosed before operation. In fact, we know of no other diagnostic means which would have enabled us to make the correct pre-operative differential diagnosis between multiple polyposis and hypertrophic gastritis, since from the clinical, roentgenologic and laboratory standpoints, the case showed the "typical" picture of multiple gastric polyposis. The authors strongly advise the more routine use of gastroscopy in the diagnosis of gastric conditions.

Tumor tissue recovered from the stomach may indicate the presence of multiple polyposis.<sup>14,15,17</sup> Here the diagnosis of malignant degeneration may be in doubt, since the usual absence of the submucosa in such cases makes the demonstration of invasion more difficult. The condition may be actually missed by the operation surgeon if palpation alone is relied on. The authors advise gastrotomy and inspection of the mucosa in all suspicious cases.

#### TREATMENT

The proper treatment is surgical in all cases. Because of the danger of malignant degeneration, a partial gastrectomy should

be done, removing as much of the growth-containing area as possible. Excision of single polyps and destruction of their bases is a less efficacious method. If there is only a small number of discrete polyps and if the patient's condition does not warrant gastrectomy, excision is indicated. Often the involvement of the mucosa is so extensive that nothing short of gastric resection is worth while.

#### PROGNOSIS

The percentage of malignancy in multiple polyposis of the stomach is much less than in the intestinal variety. The intestinal variety almost invariably ends in cancer. There is evidence that multiple polyposis of the stomach may remain benign for a long term of years, in contradistinction to colonic polyposis which becomes malignant earlier. In our previously reported series, only 12 per cent were malignant. Recently, however, one of us has collected all the reported additional cases since 1925, numbering twenty-nine cases, and adding two new personal ones. The percentage of malignancy in this new series is definitely higher than in the present series. A review of these additional cases will be reported in an article to follow. Although severe gastric hemorrhage is present in 8 per cent, there are no reported cases of death due to this cause.

#### CONCLUSIONS

1. Multiple gastric polyposis may be either of congenital or inflammatory origin. Each type has certain gross characteristics by which it may often be identified.

2. In contrast to colonic polyposis, gastric polyposis has no definite hereditary factors. The percentage of malignancy is less and malignancy occurs much later in the course of the disease.

3. Symptoms are not characteristic and often absent, leading to failure to make the proper diagnosis.

4. The most valuable diagnostic aid is the roentgenogram. Achylia, myxorrhoea

and gastric bleeding are strong presumptive signs. Achylia is present in 90 per cent of cases. The diagnosis may be missed in spite of every precaution. The more routine use of gastroscopy will greatly improve our ability to make the correct diagnosis.

5. The disease often remains benign over a period of many years.

6. The treatment is preferably radical surgical removal.

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# THE SURGICAL MANAGEMENT OF THE BLEEDING PEPTIC ULCER

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ADVANCING knowledge brings with it changing methods. Only a few decades ago, the frontier of scientific advance was opened up by a small number of men, working as individuals, who laid the foundations of scientific medicine. That day has largely passed, and now we see groups of men, pure scientists and clinicians, pooling their combined knowledge to solve the problems of modern medicine. As knowledge advances, methods of treatment change. The day when a single physician felt equipped to treat all the ills of mankind has passed and today the more complex diseases are best treated by the combined and harmonious efforts of competent physicians and surgeons.

These general remarks have a direct bearing on the entire ulcer problem, and especially on the complicated problem of the bleeding ulcer. Today most internists and many surgeons treat bleeding ulcer by medical means, secure in the false doctrine that the mortality in bleeding ulcer cases is so low as to be almost negligible. We wish to emphasize and we will repeat that the bleeding ulcer is not a so-called "medical" disease to be treated purely along medical lines; nor is it a so-called "surgical" disease requiring operation, in the sense that a perforated ulcer requires immediate operation. The bleeding ulcer is a disease which demands the combined knowledge and the pooled resources of a keen internist and a competent surgeon. All too often the surgeon is not summoned until a week or more after the first hemorrhage in a case which has continued to bleed under medical treatment.

Of course the cases of bleeding ulcer must be sifted from the larger group of massive

hemorrhage from the upper gastrointestinal tract. Bortz<sup>1</sup> has reviewed the numerous lesions which can cause such bleeding from the stomach. Balfour<sup>2</sup> points out that lesions of the spleen, liver, gall-bladder and even of the appendix may cause bleeding. Bulmer, quoted by Finsterer,<sup>3</sup> reports that 5.3 per cent of acute upper intestinal hemorrhages are due to the varices of cirrhosis and 1.5 per cent to gastric carcinoma, but the great majority of such cases—89 per cent—are due to gastric or duodenal ulcer.

The medical man sees these patients first and his is the responsibility of having the patient hospitalized and taking the first steps toward making the diagnosis.

The incidence and mortality of bleeding in ulcer cases vary with groups studied. Emery and Monroe<sup>4</sup> found that 38.8 per cent of their patients bled, and of these 4.1 per cent died of hemorrhage. Gordon-Taylor<sup>5</sup> believes that 10 per cent of chronic ulcers and 20 to 25 per cent of the more severe types of ulcers are complicated by hemorrhage. Allen and Benedict<sup>6</sup> studied 1,804 cases of duodenal ulcer and found that 628, or 30 per cent, of the patients bled. Of this number, 138 had sudden severe hemorrhages in which the mortality was 14.5 per cent. Meulengracht,<sup>7</sup> the great exponent of medical treatment by frequent feedings, reports a mortality of 1.3 per cent in a group of 368 consecutive cases. He does not record the separate mortality of massive hemorrhage in his cases. Kruse<sup>8</sup> is of the opinion that the mortality is in the neighborhood of 5 per cent. Hinton<sup>9</sup> reported a mortality of 11 per cent in eighty cases of severe gastric and duodenal hemorrhage treated con-

servatively. Goldman,<sup>10</sup> reporting from the San Francisco Hospital, cites a mortality of 11.1 per cent from exsanguination alone and 15 per cent when the deaths from complications associated with hemorrhage are added. The incidence of gross hemorrhage in his cases was 38 per cent. In contrast to these statistics from a general hospital are Lahey's figures from his clinic practice. His incidence of massive hemorrhage is 18 per cent<sup>11</sup> and he states that 5 per cent of such patients die on medical treatment.<sup>12</sup> Lahey states further that 40 per cent of patients who have bled once will not be controlled by medical treatment and 80 per cent of patients who have bled two or more times will not be controlled by medical treatment.

From such varied figures of incidence and mortality one can only conclude that the true incidence of hemorrhage from peptic ulcer is established in certain classes of patients but not in the general ulcer population. It seems fair to conclude also that the mortality from massive hemorrhage complicating peptic ulcer, in this country at least, is 5 per cent or more on medical treatment. That the incidence and the mortality of ulcer hemorrhage are less in females than in males has been established.<sup>3</sup> That the incidence and the mortality increase with age, arteriosclerosis and hypertension is also known.<sup>3,4</sup> That mortality rapidly rises with a second or third hemorrhage closely following initial bleeding is self evident.

Mortality figures for the surgical treatment of bleeding ulcer vary greatly. One must not forget that surgery is only resorted to in severe bleeding and surgical mortality figures cannot therefore be compared with the general run of medical mortality figure. The present tendency of many internists to treat bleeding cases until continued bleeding on medical management finally brings the cases to the operating table results in far too numerous fatalities. Finsterer<sup>3</sup> has demonstrated that the time element is all important. In thirty-five early resections for massive bleeding he had one death, or a mortality

of 2.8 per cent; in forty-two late resections for massive hemorrhage he had thirteen deaths, or a mortality of 31 per cent. Resection is not always possible or necessary. In forty-two early operations of various types, all for severe bleeding, Finsterer had two deaths, or a mortality of 4.8 per cent. He maintains that this is the only fair figure to compare with medical mortality rates, for his early operation means operation within twenty-four to forty-eight hours of the initial bleeding. What is more, this figure must be compared with the mortality of medical treatment in cases of massive hemorrhage, and not the medical mortality in groups of consecutive cases.

The cases reported in this study are consecutive cases admitted to the Lankenau Hospital during the past four years and the Abington Hospital during the past twelve years. Four surgeons and twelve medical men handled the patients. While the series is small, it throws some light on the incidence of ulcer complications in private patients and the better class of ward patients.

TABLE I

	No. of Cases	Per Cent
Total number of ulcer cases.....	343	
Perforation.....	81	23.6
Gross hemorrhage.....	61	18.1

Table I shows the incidence of perforation and gross hemorrhage in the series. Only cases of gross hemorrhage, such as copious hematemesis or melena, frequently associated with syncope and always associated with weakness and a marked fall in the hemoglobin and red count, are included.

TABLE II

	No. of Cases	Per Cent
Hemorrhage from duodenal ulcer..	44	70.9
Hemorrhage from gastric ulcer....	15	24.2
Hemorrhage from anastomotic ulcer	3	4.8

Table II shows the distribution of the ulcers. As is the case in most studies, duodenal ulcer was the most frequent site of hemorrhage, 70.9 per cent in this series. Two of the anastomotic ulcers were jejunal, one occurring after a gastroenterostomy performed eleven years previously and the other after a pylorectomy performed nineteen years previously. The third was gastric, occurring at the site of a sleeve resection done eight years previously.

TABLE III

	Combined Figures	Cases Medically Treated	Cases Operated
No. of cases.....	62	40	22
Deaths.....	8	3	5
Mortality.....	12.9 per cent	7.5 per cent	22.7 per cent

Mortality figures for the series are listed in Table III. The general mortality in these cases of gross hemorrhage was 12.9 per cent. It is interesting that five of the fatal cases had duodenal ulcers and four had gastric ulcers. All of these patients were men and all but one were over 40 years of age. Of the forty patients who were treated medically, three died. The mortality on medical treatment was 7.5 per cent. Two of the three patients died of exsanguination. Bronchopneumonia was superimposed on exsanguination in the third.

Twenty-two cases came to surgery. There were five deaths, making the mortality 22.7 per cent. These patients are purposely listed as cases operated and not as cases surgically treated. Not one of them was operated upon within the twenty-four to forty-eight hour time limit of Finsterer. Five were operated on thirty or more days after the onset of bleeding and one of these, a fatality, was still bleeding at that time. Twelve of the twenty-two operations were cases which came to surgery as medical failures where the surgeon was first called in five or more days after the initial hemorrhage, often after one or more successive

hemorrhages and usually in the face of continued bleeding. Four of these twelve died and the mortality of 33 per cent which ensued represents the mortality in surgically treated medical failures. While the patient and the family doctor occasionally delayed in seeking hospitalization, the internists were chiefly responsible in withholding surgery until the eventual operation was looked upon as a last resort. Of the ten operations which were procedures of election, the only fatality resulted from bundle branch block which developed on the eighth post-operative day.

From this series we have learned several lessons. Additional support is given to the fast accumulating evidence that an appreciable number of bleeding ulcer cases will die of exsanguination on medical treatment alone. Every case of hematemesis or melena should be hospitalized at once. Such cases should be seen immediately by a medical man and a surgeon, both of whom should realize that the cases are emergencies requiring speed but never haste. If the case is seen early, there should be time for a short period of observation to make a diagnosis. During this period, we believe the Meulengracht régime should be followed unless vomiting and gastric distention demand the Jutte tube and parenteral fluids. Unless the bleeding continues unabated, barium by mouth may be given to aid in diagnosis. The danger in this procedure is not in the giving of barium, but in the leaded glove of the fluoroscopist. Alvarez<sup>13</sup> cites a case of hemorrhage from a duodenal ulcer after violent abdominal massage.

Within the first twenty-four hours an effort should be made to judge whether or not the patient will survive. According to Allen and Benedict,<sup>6</sup> the eventual survivors pick up rapidly after their first prostration. The prediction as to survival should be based on the severity of bleeding, the patient's reaction to that bleeding, the patient's age and sex, and the presence or absence of vascular disturbances. Allen<sup>14</sup> believes that the age of a patient has more

bearing on the cessation of hemorrhage than any other factor, the mortality increasing greatly in patients over 50 years of age. Jones<sup>15</sup> suggested transfusions as an index to whether or not bleeding will continue. He pointed out that with each transfusion the beneficial effect of blood is less and said that if a second transfusion is necessary within forty-eight or seventy-two hours, one should transfuse and operate. If a Jutte or Levine tube is passed on admission, decompression will be beneficial and additional information can be secured concerning the continuation of bleeding after a primary transfusion.

#### OPERATION

If operation is to be undertaken it should be done only in definite cases of ulcer. Massive hemorrhage in a man over 50 who is known to have an ulcer and who does not rally soon after the initial hemorrhage is the most obvious indication. In the acute bleeding which occasionally is the first sign of a chronic ulcer but may be due to other lesions, the experience and judgment of the surgeon and internist must answer the question. As a rule bleeding from an acute ulcer is venous and less serious than the arterial bleeding from a chronic ulcer.

If operation is to be done, it should be undertaken either within the first twenty-four or forty-eight hours or after bleeding has ceased and the patient is in good condition. If patients are seen early, the decision for or against early operation assumes great importance. When a patient has been seen early, intervention in the dangerous middle period is a clear indication of faulty judgment.

When operation is undertaken, it should be done with the sole intention of controlling the bleeding directly. By direct attack upon the source of bleeding is meant direct localization and exposure of the ulcer, whether gastric or duodenal. In the more fortunate cases immediate resection of the ulcer may be done without greatly increasing the risk of surgery *per se*. In other cases

exclusion of the ulcer area may be effected and restoration of continuity accomplished at some additional risk but still within mortality figures that are not prohibitive. Surgical judgment is in the highest degree necessary. We wish to call special attention to the value of anterior gastroduodenotomy in the diagnosis of obscure cases of ulcer hemorrhage.<sup>16</sup> The following case will illustrate the value of this procedure:

J. P., male, 58 years of age, complained thirty years ago of symptoms characteristic of ulcer, i.e., discomfort about two hours after meals, relieved by food or alkalis, belching of gas and sour material, with periods of remission and freedom from symptoms. On October 22, 1919, he was admitted to the Lankenau Hospital on the service of Dr. John B. Deaver. For three to four years previously he had noticed that his stools were black at times and he would occasionally vomit coffee ground material. Three days before admission he vomited some blood and fainted. Recovering consciousness he had a similar attack three hours later, vomiting a teacupful of bright blood and again fainting.

On admission he was obviously exsanguinated. His physical examination was otherwise negative. A diagnosis of bleeding gastric or duodenal ulcer was made and he was placed on a medical régime under which he improved rapidly.

Eleven days later he was operated upon. The stomach, duodenum, gall-bladder, liver and spleen all appeared normal. The stomach was opened and explored, but no lesion was found. The appendix, which showed a chronic condition, was removed.

Eleven months later he was readmitted with recurrence of gastric symptoms and black blood in his stools. Roentgenologic examination showed some constriction of the duodenum, thought to be due to adhesions. The stomach emptied completely in four and one-half hours. Bearing in mind the previous negative exploration, a diagnosis of purpura hemorrhagica intestinalis was made and medical treatment was instituted. His symptoms disappeared, the bleeding stopped, and the follow-up five months later found him well.

His history from that time on may be abbreviated as one of remissions with complete absence of symptoms, interrupted at intervals

of six to twelve months by periods of gastric symptoms with melena and hematemesis.

When first seen by the senior author in October 1933, he had been well for many months. Two weeks before admission to the Abington Memorial Hospital, however, his stomach symptoms had returned in severe form. Two days before admission he had vomited coffee ground material and on the day of admission he had a severe gastric hemorrhage of a quart and one-half of bright red blood. His hemoglobin was 62 per cent; red blood cells 2,930,000; white blood cells, 21,600; coagulation and bleeding time normal. Blood continued to be present in his stool and ten days later his hemoglobin had fallen to 52 per cent; the red blood cells were 2,920,000 and the white blood cells were 7,000. His general condition seemed much improved. Roentgenologic examination showed complete emptying of the stomach in six hours and no persistent defect of the stomach or duodenum. It was thought that he had a chronic posterior ulcer of the duodenum. Eight months later his gastric symptoms returned and he had a severe hemorrhage by mouth and bowel for which he was readmitted to the Abington Hospital in a condition of marked exsanguination. His hemoglobin was 34 per cent; red blood cells 2,140,000; white blood cells, 19,500. He was given fluids parenterally and a transfusion the following day.

On June 8, 1934, his abdomen was reopened through the former scar and dense general adhesions encountered, involving the pyloric portion of the stomach and the duodenum. These organs, with the transverse colon and the gall-bladder, were bound together and to the inferior surface of the liver. There was no evidence of cirrhosis. The spleen was not enlarged. There was no diverticulum of the small intestine. The gall-bladder was dissected free from enveloping adhesions and removed. No lesion was found in the stomach. The duodenum was then freed and no sign of disease was found in the anterior wall nor could a crater be detected on the posterior wall. At a point just about opposite the right border of the gastrohepatic omentum, an area of inflammatory infiltrate was found and it was decided to open the duodenum to inspect its interior at this point. This revealed a large ulcer, almost 1 inch in diameter, on the posterolateral wall. In its bed a vessel passing from

above downward could be seen. The ulcer bed was partly in the pancreas and extended upward and to the left where the duodenal wall was guarded by the attached gastrohepatic omentum. It had eroded through the entire thickness of the duodenum and it was thought to be in intimate relation to the common duct. Safe excision seemed out of the question. It was decided to destroy the vessel with the actual cautery, to cauterize the remaining ulcer bed and to perform a wide pyloroplasty. The patient made an uncomplicated recovery.

On February 13, 1938, the patient was symptom-free and had had no further bleeding.

Figure 1 shows the nature of the lesion and the operation in the above case. Such ulcers may not infrequently be felt as craters situated posteriorly but still palpable through the anterior duodenal wall.

If the ulcer is high, not too extensive, capable of mobilization, and if the patient is operated on within forty-eight hours and is in good condition, the curative operation of resection may be undertaken. One should not be tempted, however, to subject these bleeding patients to too much surgery. This is the time for the saving of lives, not for the curing of ulcers. The situation is somewhat similar to operations for intestinal obstruction due to rectal or colonic growths where obstruction is relieved at a primary operation and at a later operation the growth is removed.

If the ulcer is low, too extensive, and if the patient's condition is grave, the bed of the ulcer may be inspected for the actual bleeding point, which can frequently be found. The bleeding point may be sealed with the ball electrode and an encircling stitch of chromic catgut placed through the tissues above and below. If the point is not discovered, similar procedures may still be adopted and at times it may be possible to mobilize overhanging edges and bring them together by suture. Small radiating incisions through the indurated edge may be of advantage in large excavated ulcers. The immediate objective of stopping hemorrhage must be foremost in the surgeon's mind. The probability of secondary opera-



tion should lead him to adopt the simplest procedure which is consistent with control of hemorrhage and permits subsequent

Gastroenterostomy has little to offer in the treatment of bleeding ulcer. In acute ulcer, it may be of some use through decom-

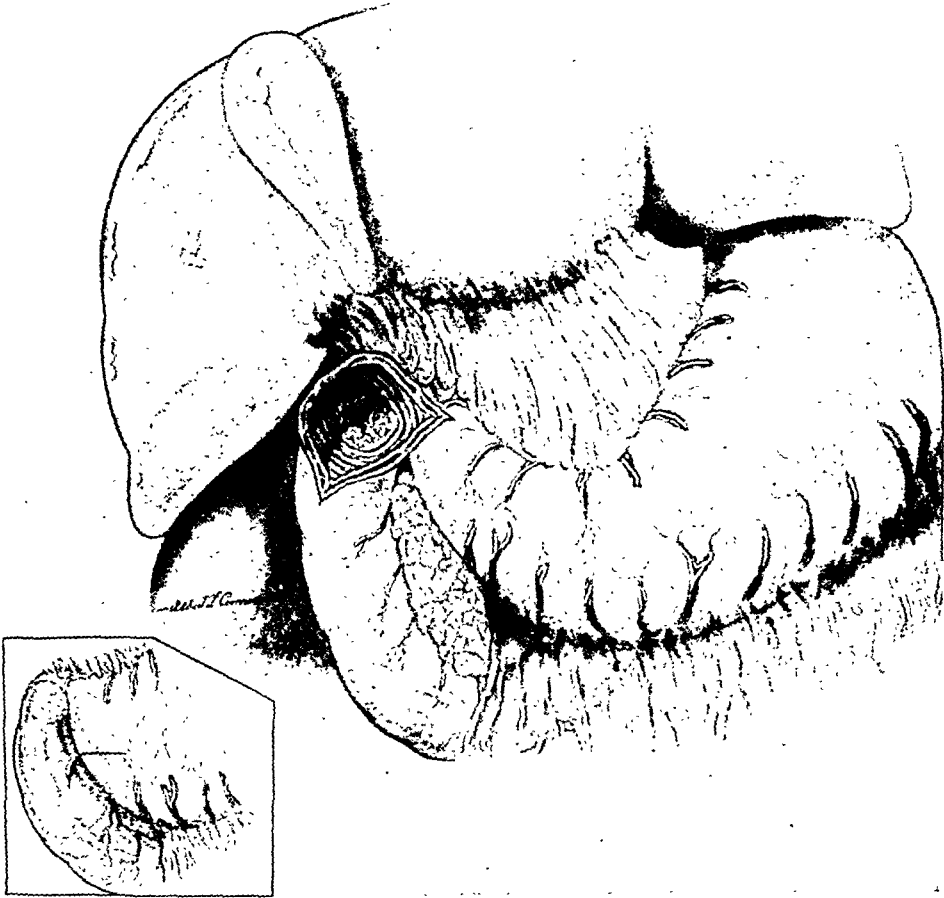


FIG. 1. Approximate position and size of posterolateral ulcer. Inset shows large gastro-duodenostomy with arrow suggesting probable diversion of gastric contents away from ulcer bed. (From Pfeiffer, in *Ann. Surg.*, 103: 475, 1936.)

operation of more definitely curative value. A great advantage of anterior gastro-duodenostomy for exploration is the opportunity thus afforded to terminate the operation as a gastroduodenostomy. While this procedure is not recommended as a definitely curative operation for ulcer, it would seem that it may have that effect as illustrated in the above striking instance. The mortality of such a procedure is extremely low. It may be done without exceeding the vitality of an exsanguinated patient and it does not interfere with a subsequent radical operation should that be considered wise.

pression, thus allowing coaptation of the ulcer surfaces. In chronic ulcer it can have no such effect.

Transfusions during or after operation are often imperative and can be facilitated by tying a cannula into an ankle vein and starting a saline infusion before making the abdominal incision. If blood is needed, it should be given in massive amounts.

When an ulcer is found on the anterior surface of the duodenum, one should remember that such ulcers may accompany a bleeding posterior ulcer which may be overlooked if only the superficial lesion is dealt with.

In cases of bleeding which have been controlled on medical treatment, operation must be considered because of the likelihood of another hemorrhage in the future. Here judgment is essential and the probability of continued symptoms with the possibility of future hemorrhage must be weighed against the risk of operation. Bleeding means progression of the ulcer and if it occurs during medical treatment, it means progression in spite of treatment. In the latter type of case, operation is more imperative than in cases which bleed during a lapse in medical treatment. Partial gastrectomy with removal of the ulcer is probably the best curative procedure. Resection "zur Ausschaltung" and cautery excision followed by suture and pyloroplasty are alternate procedures.

#### CONCLUSIONS

The treatment of bleeding gastric and duodenal ulcers is a complicated problem. All cases should be hospitalized at once. All cases should be attended by an expert internist and a competent surgeon.

A certain percentage of patients will die on medical treatment. Every effort should be made to single these patients out within twelve to twenty-four hours after the onset of bleeding. A final decision as to whether or not the patient should be operated on should be reached within the next twenty-four hours. Trial by transfusion can be done in this period.

At operation, control of hemorrhage is the primary consideration. Gastroduodenotomy is presented as a means of

localizing and dealing with low posterior duodenal ulcers.

In patients whose hemorrhage has been controlled by medical or surgical measures, a curative operation should be done as indicated.

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# CHRONIC GASTRIC ULCER

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CHRONIC gastric ulcer occurs less frequently in this country than abroad; one reason for this is that in this country chronic gastric ulcer is infrequently associated with ulcer of the duodenum.<sup>10</sup>

The similarity of the symptom complex associated with both benign gastric ulcer and benign duodenal ulcer has led to the thought that they are lesions of similar type. They differ, however, not only from the standpoint of the type of tissue in which the ulceration occurs, but also from that of the variable pathologic nature of the lesions themselves and from that of their response to both medical and surgical treatment. For example, the secretions of the stomach are acid, whereas those of the duodenum are alkaline. The primary ulcer which occurs in the first portion of the duodenum is never malignant, whereas that which occurs in the stomach has a 10 per cent chance of becoming malignant according to Stewart, and a 20 per cent chance of this according to Katsch. The healing of a duodenal ulcer leaves a scar which constantly deforms the duodenum, manifesting its presence on inspection and palpation, while many gastric ulcers, under appropriate treatment, whether medical or surgical, frequently heal without trace; a very few produce hourglass deformity. Gastric and duodenal ulcers differ in physicochemical response to similar operations. If partial gastrectomy is performed for gastric ulcer, post-operative relative achlorhydria is the rule and occurs in almost all cases. On the other hand, when partial gastrectomy of similar magnitude is performed for duodenal ulcer, relative achlorhydria results in from only 25 per cent (Billroth 1)<sup>11</sup> to 65 or 70 per cent (Polya)<sup>8</sup> of the cases.

Of first importance, when a patient presents himself with a history suggesting benign ulceration of the stomach or duodenum, is that roentgenologic examination be made by a competent roentgenologist to determine the exact situation of the lesion. If the lesion can be proved by roentgenologic examination to be in the duodenum, and if a medical regimen is chosen for treatment, the possibility of the duodenal lesion being or becoming malignant is practically nonexistent. A gastric ulcer, on the other hand, even though it gives rise to symptoms like those of ulceration of the duodenum, always should be regarded with the suspicion that it is an ulcerating carcinoma; this is particularly true of the prepyloric lesions as well as of the lesions on the greater curvature. At The Mayo Clinic, in dealing with gastric ulcers, we proceed on the assumption that chronic ulcerating gastric lesions are malignant until they are proved to be benign. This has helped us to early recognition and satisfactory removal of many small carcinomas of the stomach which, because of their temporary beneficial response to a medical regimen, might otherwise have been allowed to grow, under the erroneous impression that the lesions were benign.

## INDICATIONS FOR OPERATION

The treatment of gastric ulcer is dependent on several factors, among which are: (1) the duration and type of symptoms; (2) the healing of the lesion or its failure to heal under a medical regimen carried out in a scientific fashion; (3) the presence or absence of a crater, especially with respect to bleeding, and (4) the presence or absence of pyloric obstruction.

When the symptoms have been of short duration and the ulcer is small, every

attempt should be made to induce healing of the lesion by non-surgical means. Such methods of treatment have been commented on in detail by Eusterman,<sup>1,2</sup> Jordan,<sup>3,4</sup> and others. A favorable clinical response to such medical treatment consists of relief of pain, disappearance of blood from the stool and disappearance of the niche seen on roentgenologic examination. In most instances these criteria can be assumed to be of immediate value in determining the ability of the lesion to respond to medical measures; however, a number of years ago the late Charles McVicar called attention to the fact that such a response is not confined to benign gastric ulcers, but that it may seem to occur as well in treatment of small, ulcerating, malignant lesions of the stomach. Exact information should be obtained from the patient as to whether a medical regimen has been instituted previously and evaluation should be made of the accuracy with which it was carried out and of the results which have followed its use, for if one or more attempts have been made to cause the lesion to heal by a carefully controlled medical regimen, but with recurrence of the ulcerating lesion, the lesion should be removed surgically.

In the period during which our patients with gastric ulcer are being kept under observation and medical treatment is being employed, even though the lesion appears to be healing satisfactorily, the patient is advised to undergo reëxamination at intervals of three months for the first year, regardless of the presence or absence of symptoms, in order to determine for sure that the ulcer has remained healed. If the ulcer recurs or if it fails to heal, surgical exploration is thought advisable. In a few cases, unfortunately, wherein response to the initial medical regimen seemingly was satisfactory, the patient failed to be impressed with the importance of repeated reëxaminations, either at the clinic or elsewhere, and returned later with carcinoma of the stomach.

*Perforating Gastric Ulceration with Crater.* The perforating gastric ulcer, with a crater

more than 1.5 cm. in diameter, is not likely to respond to a medical regimen. These ulcers, for the most part situated on the lesser curvature, will be found to have penetrated into the gastrocolic omentum, whereas some, situated on the posterior wall, in most cases near the lesser curvature, may penetrate into the capsule of the pancreas. It might be inferred that this type of lesion is one in which malignant cells are most likely to be present. Although this may be the case, especially if the lesions have large craters, not infrequently the smaller ulcerating gastric lesions may be in highly malignant ulcerating carcinomas which already have involved the lymph nodes when the patient presents himself for examination or treatment.

*Gastric Ulcers Producing Pyloric Obstruction.* Ulcerating lesions of the stomach, either benign or malignant, if they occur on the lesser curvature of the stomach, not infrequently produce so much disturbance of motility, as disclosed both on clinical and on roentgenologic examination, that only the presence of pyloric obstruction can be determined and in some of these cases the lesion is suspected of being a duodenal ulcer. Particularly true is this if the patient has had an ulcer-like type of dyspepsia for a prolonged period. The following three cases, in which such lesions occurred and the patients had an ulcer-like type of dyspepsia for several years, are illustrative.<sup>7</sup>

CASE I. A man, aged 45 years, came to the clinic July 14, 1936. He had had nausea and occasional pain, with vomiting (relieved by a milk diet) of eighteen years' duration. A roentgenologic diagnosis of duodenal obstruction was made. Operation was performed July 20. A lesion of the prepyloric portion of the stomach was found and partial gastrectomy, with posterior Polya type of anastomosis, was performed. The lesion was reported to be a gastric adenocarcinoma, grade 2, secondary to gastric ulcer. After an uneventful convalescence the patient was dismissed, August 3, 1936.

CASE II. This patient, a man aged 50 years, registered at the clinic on June 9, 1936. He presented a history of polycythemia and an ulcer-like type of dyspepsia of eight years' duration. A roentgenologic diagnosis of duo-

denal obstruction was made. On June 19, 1936, ulcerating gastric adenocarcinoma, grade 4 (measuring 2 by 2.5 by 4 cm.), with involvement of lymph nodes was found, and partial gastrectomy with a posterior Polya type of anastomosis, was performed. The lesion was at the incisura. The patient made satisfactory convalescence and was dismissed July 27, 1936, at which time his blood count was normal. On February 26, 1937, the patient stated in a letter that the lesion had recurred, as reported after roentgenologic examination. He died in April, 1937.

CASE III. A man, 50 years of age, came to the clinic on March 23, 1936. He gave a history of an ulcer-like type of dyspepsia of seven years' duration. This dyspepsia was relieved by taking milk and soda. The patient had had recurrent hemorrhages. Roentgenologic examination disclosed what seemed to be a duodenal ulcer with obstruction. On March 27, 1936, Billroth I resection of the stomach was carried out for a subacute, perforating, carcinomatous gastric ulcer, 4 cm. below the cardia on the lesser curvature. Microscopic examination revealed the lesion to be an ulcerating adenocarcinoma, grade 3, measuring 2 cm. in diameter. There was no evidence of duodenal ulcer. The patient made satisfactory convalescence and was dismissed on April 27, 1936. He returned to the clinic September 27, 1937, for post-operative reexamination. His general condition was good and symptoms had not recurred.

Fortunately, in cases of pyloric obstruction surgical procedures are usually advised, the presence of a gastric lesion is recognized, and its appropriate treatment is carried out.

The roentgenologist's diagnosis that an ulcerating lesion of the stomach is malignant is almost certain to be correct, particularly if the meniscus sign of Carman is seen in the course of roentgenoscopic examination. But the fact that an ulcer of the stomach is reported as being probably benign by the roentgenologist does not exclude the possibility that the lesion is carcinomatous. On many occasions at operation, with small gastric ulcerations readily visible and palpable, the fact that the lesion was carcinomatous was not

recognizable until microscopic examination proved the fact.

#### DIFFERENTIAL DIAGNOSIS OF BENIGN AND MALIGNANT GASTRIC ULCERATION

In the Annual Oration for 1936, delivered before the Medical Society of London, Sir James Walton said, when referring to carcinoma of the stomach secondary to peptic ulceration: "Today the figures of Stewart are generally accepted. . . . Nine and one-half per cent of cases of chronic ulcer become carcinomatous and 17 per cent of cases of carcinoma originate in a chronic ulcer." Quoting further, Walton said: "Clinical criteria are notoriously unreliable. . . . The history of carcinoma in its early stages may also closely resemble that of chronic ulcer, so that an even higher percentage of the cases diagnosed clinically as chronic ulceration become malignant. . . . In early cases the diagnosis of carcinoma may only be possible on microscopic examination, while in the later stages the mass of growth may be so extensive that it is impossible to determine with the naked eye whether the ulcer is primary or secondary. Microscopic examination will nevertheless often reveal characters of the original ulcer."

It seems to me that Walton has concisely stated the case against gastric ulcer from the standpoint of the menace of carcinoma. In our experience at the clinic, each year a considerable percentage of patients operated on for carcinoma of the stomach have related, in their early histories, symptoms indistinguishable from those of benign ulceration. Unfortunately many of the patients had been treated medically elsewhere for long periods before roentgenologic examination was carried out and revealed an intragastric malignant lesion.

#### TYPES OF OPERATION

The types of operation available in treatment of gastric ulcer consist of (1) partial gastrectomy followed by anastomosis

of stomach and duodenum (Billroth 1) or of stomach and jejunum (Polya-Balfour); (2) excision of a portion of the stomach containing the gastric ulcer or destruction by cautery of the gastric ulcer, in some cases combined, and in other cases not combined, with gastro-enterostomy; (3) transgastric excision of the ulcer from the posterior wall of the stomach; and (4) sleeve resection of the stomach.

The type of operation to be selected for each case is dependent on the type of lesion, its size, its situation, its accessibility, the amount of deformity of the stomach that would result from its removal and the general condition of the patient. In selection of the type of operation most suited to the patient or the lesion, the general statement seems justified that partial gastrectomy, particularly for large gastric ulcers, with either a Billroth 1, or a Polya, or a Polya-Balfour type of anastomosis, is the preferable procedure, providing it can be performed with a mortality as low as 3 or 4 per cent. The reasons for this are (1) the prompt relief of symptoms obtained; (2) the almost total absence of recurring ulceration; and (3) the fact that partial gastrectomy is the preferable procedure should the lesion prove to be malignant.

There is a place for destruction by cautery of the ulcer or for segmental resection of a portion of the stomach containing the ulcer, either operation combined with gastro-enterostomy. Whereas the mortality of partial gastrectomy for large gastric ulcers, in our experience at the clinic, has been approximately 3 to 4 per cent, destruction by cautery or excision of a gastric ulcer, combined with gastro-enterostomy, usually can be performed with a mortality not greater than that of gastro-enterostomy alone. Furthermore, the risk of any operation is one of the very important factors regarding the type of operation to be chosen. The working principle can be accepted that excision or destruction by cautery of small gastric ulcers, combined with gastro-enterostomy,

is a suitable operation of low risk and that partial gastrectomy, an operation of greater risk, can be reserved for the large, penetrating, frequently hemorrhagic, gastric ulcer.

During 1936, partial gastrectomy for benign and malignant lesions of the stomach and duodenum was performed in 213 cases at The Mayo Clinic.<sup>9</sup> Of these operations, 104 were for benign lesions, with a mortality of 3.8 per cent. Of these 104 operations, in thirty-three cases the operation was primary partial gastrectomy performed for gastric ulcer. An additional five patients had undergone gastro-enterostomy previously; in these five cases, therefore, in addition to partial gastrectomy, removal of the gastro-enterostomy and closure of the jejunal opening was carried out.

In twenty-five cases in which gastric ulcers were removed by local excision, combined with gastro-enterostomy or destruction by cautery, no deaths occurred.<sup>9</sup> On only two occasions in the last three years have I been satisfied to perform segmental resection of a portion of the stomach containing the ulcer without also performing gastro-enterostomy. On both of these occasions the lesion was very large and was situated just below the esophageal-gastric junction. Both patients were large and obese and partial gastrectomy would have been exceedingly difficult and would have been attended with a high risk because neither patient was in good condition. On that account, excision of that portion of the gastric wall which contained the ulcer was carried out, with good results, which have persisted to date in both cases.

Dr. W. J. Mayo has told me that he obtained, in several cases, similar good results from excision of certain large, perforating gastric ulcers situated high on the posterior wall of the stomach. His approach to the lesion was through the anterior wall. After he had excised the lesion he sutured the edges of the stomach together from the inside and carried a portion of the gastrohepatic omentum

posterior to the stomach, to serve as a patch over the healing of the anastomosis.

As has been indicated, whenever pos-

sible, I prefer the operation of partial gastrectomy for accessible, large, perforating gastric ulcers. I use the Billroth I, the Polya, and the Polya-Balfour types of anastomosis; the choice of one of these procedures depends on the situation of the ulcer, the mobility of the duodenum, the amount of fat in the transverse mesocolon and the accessibility of the avascular spaces in the transverse mesocolon. Partial gastrectomy can be applied in nearly all cases of gastric ulceration.

Gastric ulcers situated high on the lesser curvature and those situated high on the posterior wall of the stomach are frequently reported, on the basis of roentgenologic examination, to be of questionable accessibility to surgical removal. Their high situation is likely to be considered an additional reason for continuation of med-

ical treatment which has failed to cause healing of the ulcer previously. That all benign gastric lesions are accessible to surgical treatment is, therefore, a point which deserves emphasis. On several occasions, because of the perforating nature of the lesion and its attachment, particularly to the capsule of the pancreas, and because of contraction and fixation of the stomach in the vicinity of the lesion, the appearance has been that the lesion was higher than really it was.

In a case in which I operated last year, a man of 68 years had a large, recurring, perforating gastric ulcer, 3 cm. in diameter, high on the lesser curvature. (Fig. 1.) No evidence of healing of the ulcer occurred on medical treatment. The reason the ulcer seemed so high was that it had perforated and attached itself to the capsule of the pancreas and to the gastrocolic omentum. When the ulcer was freed from its attachment to the pancreas, it



FIG. 1. Large, recurring, perforating gastric ulcer situated high on the lesser curvature of the stomach.

was found that there was a considerable amount of normal stomach above it, which enabled performance of satisfactory par-

In my experience the Billroth I type of anastomosis, following partial gastrectomy and partial duodenectomy for duodenal



FIG. 2. A, perforating gastric ulcer (hemorrhagic) on lesser curvature; B, post-operative roentgenogram following Billroth I resection of the stomach and the gastric ulcer.

tial gastrectomy of the Polya-Balfour type.

Removal of that portion of the lesser curvature which contains a gastric ulcer, as in the Billroth I or the Hofmeister-Polya resection, enables the surgeon to preserve a sufficient amount of the body of the stomach, and particularly the greater curvature, for its anastomosis with the duodenum or with the jejunum. (Figs. 2A and B, and 3A and B.)

In addition to these methods, the trans-gastric method of removal of some of the ulcers on the posterior wall, at the fundic end of the stomach, by the method of Mayo previously referred to, has given very good results.

The particular field of usefulness of the Billroth I type of anastomosis lies in the ability it gives the surgeon to remove perforating ulcers high on the lesser curvature without removing too much of the stomach itself. Sufficient mobility of the duodenum must be present, however, to allow attachment of it to the proximal segment of the stomach without tension.

ulcer, has not been as satisfactory a method of anastomosis as is the Polya type, and in a few of my cases duodenal ulcer has recurred. Apparently, however, results are different when the operation is performed for gastric ulcer. There ulceration does not recur. In such cases, study of gastric acidity subsequent to operation discloses that relative achlorhydria is obtained in practically every instance;<sup>8</sup> this is contrary to the low occurrence of relative achlorhydria after the Billroth I type of anastomosis for duodenal ulcer, in which circumstance relative achlorhydria develops in but 25 per cent of the cases.<sup>11</sup>

In my experience most cases of malfunctioning gastrojejunal anastomosis, both subsequent to posterior gastro-enterostomy and to posterior Polya types of anastomosis following resection of the stomach, have been the result of choosing to make the anastomosis posterior to the colon, through a very large, fat transverse mesocolon. In such cases it would have been better to have chosen a longer loop of jejunum and to have made the anastomosis anterior



to the transverse colon, as advocated by Balfour, combining the operation with entero-anastomosis.

gastrectomy for benign gastric ulcer, I have operated in only five cases in which gastric ulcer recurred after previous ex-



FIG. 3. A, gastric ulcer high on the lesser curvature and posterior wall; B, post-operative roentgenogram following Hofmeister-Polya type of removal of the stomach. (The dilatation of the lower portion of the esophagus shown opposite upper safety pin is not pathologic, but attributable to regurgitation of barium.)

The operation of sleeve resection for gastric ulcer was performed more frequently years ago than at the present time. It is an operation of considerable usefulness in a selected group of cases. Such cases are those in which partial gastrectomy of the Billroth or Polya type does not seem indicated because of the mechanical difficulties entailed or because excision of the segment of stomach containing the ulcer would not remove enough gastric tissue.

#### RESULTS OF OPERATION

The results of a properly chosen, properly performed operation for gastric ulcer are among the best in surgery and recurrence of the ulcer, or disturbing symptoms without formation of ulcer, practically never are encountered. This is especially true when the operation performed is partial gastrectomy. Yet similar good results have followed the more conservative operations of excision or destruction of the ulcer, combined with gastro-enterostomy, in most cases. Although I have not seen a recurring ulcer after partial

cision of a gastric ulcer, followed by gastro-enterostomy. Subsequent closure of the gastro-enteric stoma and partial gastrectomy of the Billroth I, Polya, or Polya-Balfour type have been followed by excellent results and ulceration has not recurred.

In a study made of the post-operative gastric acidity of patients who had had gastric ulcer, and on whom different types of operations had been performed, the striking thing was the high frequency with which, providing adequate drainage of the stomach had been obtained following operation, relative achlorhydria was the rule. This was in contrast to the effect of similar types of operation performed for duodenal ulcer.

#### SUMMARY

Of primary importance in examining patients who give histories of peptic ulcer is to ascertain the situation of the lesion by roentgenologic examination; that is, to learn whether it is in the stomach or duodenum. This should be ascertained in

every case in which the condition of the patient permits of it, before prolonged medical treatment is instituted. The necessity of this is to eliminate the possibility that the lesion may be a malignant rather than a benign gastric ulcer; not infrequently in cases of carcinoma the early history is typically that of benign gastric or duodenal ulceration.

The treatment of gastric ulcer is dependent on several factors, among which are: (1) the duration and type of symptoms; (2) the healing of the lesion or its failure to heal under a medical regimen carried out in a scientific fashion; (3) the presence or absence of a crater, especially with respect to bleeding; and (4) the presence or absence of pyloric obstruction.

When the symptoms have been of short duration and the ulcer is small, every attempt should be made to induce healing of the lesion by non-surgical means. When roentgenologic examination discloses that the ulcer has a demonstrable crater, especially when episodes of bleeding have occurred, when the lesion is producing pyloric obstruction, or when it is prepyloric in situation or is on the greater curvature, generally speaking surgical removal of the lesion should be undertaken without delay.

A good working principle is to regard all gastric ulcers as malignant until they are proved to be otherwise. The fact that an ulcer of the stomach is reported by the roentgenologist to be probably benign does not exclude the possibility that the lesion is carcinomatous. The roentgenologist wishes such an opinion of his to be considered only as a contribution to the final diagnosis.

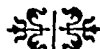
The types of operation employed at The Mayo Clinic in the treatment of duodenal ulcer have consisted for the most part of (1) partial gastrectomy of the Billroth I, or Polya, or Polya-Balfour type if the lesion

was large and perforating, and (2) excision or destruction of the ulcer, combined with gastro-enterostomy, if the lesion was small and was proved to be benign on microscopic examination. Infrequently excision of the ulcer and sleeve resection of the stomach have been employed.

The results of a properly chosen, properly performed operation for gastric ulcer are some of the best in surgery, and recurrence of the ulcer or disturbing symptoms without formation of ulcer practically never are encountered. This is especially true when the operation performed is partial gastrectomy.

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# ACUTE PERFORATED ULCER

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THIS report is based on 389 cases of acute perforated gastric and duodenal ulcers operated upon at the Receiving Hospital of Detroit during the past seventeen years. Three hundred and fifty-six have been reported previously.<sup>1</sup> Twenty-five subacute ulcers are not included. The reason for this is that the perforation was sealed over anywhere from two hours to fourteen days. During the five years preceding 1920 no acute ruptured ulcers are recorded as having entered the Hospital. Our reports seem to indicate an increase in the number of these cases. The marked increase noted in Table I for the year 1936 is hard to explain, especially as thirty-seven of the fifty cases were seen in the last six months of that year.

TABLE I  
YEAR OF PERFORATION, COMPARING NUMBER OPERATIONS  
PERFORMED WITH NUMBER OPERATED ON FOR  
PERFORATED ULCER

Year	Total Number of Operations	Perforated Ulcers
1920	763	2
1921	3383	5
1922	3747	10
1923	3650	10
1924	3524	11
1925	3681	17
1926	3672	21
1927	3973	17
1928	4228	30
1929	4096	26
1930	4243	24
1931	3673	28
1932	3473	26
1933	3523	23
1934	5048	23
1935	3776	33
1936	5020	50
1937	3938	33

## GENERAL CONSIDERATIONS

Of the total number, all but seven occurred in men, most of them in the

decade between 30 and 40 years of age. Ten occurred in men under 20 years of age, while eight men were over 60. As was naturally to be expected, the majority were native Americans, although most nationalities were included. Most had no trade or steady employment, a condition which must be considered in evaluating this report. More than one-fourth were unemployed when the perforation occurred.

Many reports show an increase in ulcer symptoms and ulcer perforation in the spring and fall, when changeable weather is encountered. Our experience has been different, and the records of this Hospital show that fewest cases occurred in winter, with an increase during spring. They were most frequent in summer and decreased in the fall. Also the recovery rate was in the same ratio, being best in winter and lowest in the summer months

TABLE II  
PERFORATIONS ACCORDING TO SEASONS OF THE YEAR

Season	Re-covered	Died	Total	Percentage Recovered
Winter.....	60	18	78	76.92
Spring.....	69	24	93	74.10
Summer.....	94	35	129	72.86
Fall.....	67	22	89	75.28
	290	99	389	

Investigation of previous history suggestive of gastric or duodenal ulcer symptoms showed that nearly 84 per cent were positive and about 13 per cent stated they had no previous dyspepsia. In the former, a perforation in the floor of an old hard calloused ulcer was found, while in the latter the walls were of the soft type with little induration about them. Of those with a previous history of ulcer, 8 per cent stated they had had no previous treatment

while 12 per cent said they had been under medical care. Use of home remedies was resorted to in 37 per cent; in the remainder treatment used, if any, was not recorded. Inadequate anti-ulcer treatment was the rule. However, while under medical care in the Hospital, Vale and Cameron<sup>2</sup> found that 5 perforated.

#### ETIOLOGY

Dragstedt<sup>3</sup> has drawn attention to the fact that ulcers can be developed in lower animals and that perforation can occur. He prefers to call them acid rather than peptic ulcers.

It is noticeable in this series, however, that most of the patients had consumed a large amount of food or filled their stomachs with fluid, especially of the carbonated variety, previous to perforation. Some few admitted the use of whiskey previous to rupture, but this was rather the exception. In five cases, liquor could be smelled in the abdomen immediately on opening it. Eight cases gave a history of trauma which apparently caused the perforation. One had had a sack of cement fall on the abdomen; another was hit by a moving belt and others were struck by various objects. The most outstanding case illustrating traumatic origin of perforation was in the case of a night watchman who lay down shortly after his evening meal. His young son awakened him by jumping on his abdomen, and this was immediately followed by violent pain. On admission to the Hospital, he was found to have a definite acute perforated ulcer.

#### DIAGNOSIS

Sudden, severe, prostrating epigastric pain was the outstanding symptom, and was reported in 97 per cent of this series. In 2 per cent epigastric distress appeared shortly before the violent pain. Once established, the pain remained constant in all but 8 per cent. In these, on opening the abdomen, temporary plugging of the opening by food or herniation of the posterior mucosal wall was found. Retch-

ing, rather than vomiting, occurred in most of this series (42 per cent). Three patients vomited continuously, but no vomiting was reported in 20 per cent.

Examination showed continuous board-like rigidity of the abdomen, which, however, was not especially evident in several elderly patients. The temperature, pulse and respiration were above the average usually reported, probably because many of the cases were admitted rather late after the perforation. The most satisfactory laboratory help was in the use of the fluoroscope, with the patient in the erect position and sitting on a cart. Finding gas beneath the diaphragm called for immediate laparotomy. However, if the history and physical findings pointed to perforation even when no gas was seen under the diaphragm at fluoroscopy, operation was advised.

#### LOCATION OF ULCER

The perforation occurred in the duodenum in 227 cases, at the pylorus in 57 instances and in the stomach in 103. As the anatomy is similar, gastric and pyloric ulcers should be classed together. Two were marginal gastrojejunal perforations. The recovery percentage was 73 per cent for duodenal perforations, nearly 77 per cent for gastric ruptures, 67 per cent in those of the pyloric type. It was 50 per cent in the gastrojejunal perforations.

#### TYPE OF OPERATION EMPLOYED

The types of operation are illustrated in Table III. We still prefer simple closure for these emergencies, but occasionally the ulcer was cauterized or a small resection done. The best results occurred with excision and pyloroplasty (90 per cent recovered). Very few closures with added gastroenterostomy have been done of late years, and as yet, no resections of the stomach have been performed in this Hospital for perforated ulcer during the acute stage.

Spinal anesthesia proved to be most satisfactory. In the early years, all cases

were drained, but of late, especially during 1937, drainage has been dispensed with in all except the very late cases.

TABLE III  
TYPE OF OPERATION EMPLOYED

Type of Operation	Num- ber Oper- ated	Num- ber Re- covered	Per- centage Re- covered
Simple closure . . . . .	307	228	74.26
Excision ulcer and closure . . . . .	31	23	69.70
Closure with gastroenterostomy . . . . .	24	19	79.16
Excision ulcer and pyloroplasty . . . . .	21	19	90.48
Gastrojejunostomy repair . . . . .	2	1	50.
Drainage only . . . . .	2	0	0

### RESULTS

Of the 389 acute perforated gastric and duodenal ulcers reported in this series, 290 recovered (74.57 per cent) while 99 (25.44 per cent) died. Eighty-four per cent of those operated on under twelve hours recovered, while only 45 per cent of those seen after twelve hours recovered. The poorest results were obtained in those with large perforations or where there was much food in the peritoneal cavity and when operation was performed late. The poorest results were also obtained in those

between 31 and 40 years of age. Two per cent of those under 20 years died and 4 per cent of those over 60 years.

### CONCLUSIONS

1. The diagnosis, treatment and immediate results in 389 acute perforated duodenal and gastric ulcers are reported.
2. Ulcer perforations appear to be on the increase.
3. Two per cent occurred in women.
4. Perforations were more common in summer.
5. Most perforations occurred with the stomach distended.
6. Several seemed to be due to trauma.
7. Epigastric pain, rigidity and finding of gas beneath the diaphragm were the best diagnostic aids.
8. Simple closure of the perforation was preferred.
9. Other findings are discussed.

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# GASTROJEJUNOCOLIC FISTULA\*

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NO disease of the abdomen commands more respect from the surgeon than gastrojejunocolic fistula. It is approached with apprehension because of its operative difficulties and its questionable outcome. Gastrojejunal ulcer, the preceding lesion of fistula, has resulted from the promiscuous use of gastroenterostomy for all types of ulcer, and, as a consequence, has brought the operation into ill-repute as far as many surgeons are concerned. It must be admitted, however, that this procedure is still efficacious in selected cases, particularly in the older group of patients with pyloric stenosis and low gastric acidity. The declining popularity of gastroenterostomy may be partially attributed to the failure of many surgeons to insist on a careful medical program of treatment long after operation, if not for life.

The first authentic case of gastrojejunocolic fistula was reported by Czerny in 1903. At operation, the fistula was removed by a block resection of the involved portions of the stomach, jejunum, and colon, and a new gastroenterostomy constructed; this method is still employed in selected cases. Verbrugge, in 1925, made an exhaustive review of the literature and reported 216 cases of gastrocolic and jejunocolic fistulas, including twenty-one cases seen at the Mayo Clinic. In ninety-five of these cases, fistula was the result of an anastomotic ulcer which had followed gastroenterostomy for duodenal or gastric ulcer. In a series of 6,214 gastroenterostomies done at the Mayo Clinic prior to 1924, Verbrugge reported that 1.4 per cent developed gastrojejunal ulcer, and that 0.06 per cent developed fistula.

A study of the literature reveals that there is a wide variation in the reported incidence of gastrojejunal ulcer. Walton reports an incidence as low as 1.7 per cent, while Strauss, Block, and Friedman state that the incidence in their cases is about 24 per cent. Wilkie's figures show an incidence of about 3.5 per cent for all types of gastroenterostomy for ulcer. The correct incidence of fistula is even more difficult to determine than that of jejunal ulcer, chiefly because of failure to make the diagnosis clinically or by Roentgen ray examination, and because of the fact that many suspected cases do not come to operation. Loewy, in 1921, reviewed the literature and reported seventy-six cases of fistula following 400 cases of secondary ulcers, an incidence of about 19 per cent. Allen, in a recent study of his cases of fistula, has reported its incidence to be about 14 per cent in cases of post-operative gastrojejunal ulcer.

## ETIOLOGY

Inasmuch as the primary etiologic factors leading to the production of gastrojejunocolic fistula are those concerned with formation of jejunal ulcer, the various theories pertaining to the development of jejunal ulcer itself will be discussed in the following paragraphs.

Gastrojejunocolic fistula is usually due to post-operative jejunal ulcer, and the original lesion is, in most instances, a duodenal ulcer. In Loewy's series of seventy-six cases, there were twenty-seven duodenal ulcers, twenty-eight pyloric ulcers, and ten gastric ulcers. In the series of fourteen cases of fistula reported in this

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## Rife—Gastrojejunocolic Fistula

study, duodenal ulcer was the original lesion in thirteen cases. One was due to extensive carcinoma of the stomach extend-

these two operations. That is, by using the above methods to divert the secretions which neutralize gastric juice, they con-



FIG. 1. Case XI. Roentgenogram showing the communication between the stomach and the transverse colon. Film was taken about ten minutes after ingestion of barium. Note the extensive filling of the small bowel. At fluoroscopy a loop of jejunum was easily visualized between the stomach and the colon.

ing into the transverse colon and will not be considered in detail in this study.

Ample evidence has been submitted to show that hyperacidity plays a major rôle in the production of peptic ulcer; this evidence also holds in regard to jejunal ulcer. The experiments of Mann and Williamson have given considerable confirmation to this theory. In operations on dogs they worked on the presumption that the increase in acid or the deficiency of alkali was an important factor in the production of ulcer. These operations were: (1) duodenectomy; (2) transplantation of the bile and pancreatic ducts to the terminal ileum; and (3) a combination of

sistently produced types of peptic ulcer similar to the subacute and chronic ulcers found in man.

The sex incidence of gastrojejunal ulcer and fistula lends support to the importance of hyperacidity as a causal factor. We know that men have higher gastric acidities than women, and that peptic ulcer is more common in men than in women; this disproportion is even more striking in jejunal ulcer and in fistula. In the group of ninety-five cases of fistula following gastroenterostomy for ulcer which were reported by Verbrugge, all but one occurred in males. It is interesting that in this small series of thirteen cases of fistula following

gastrojejunal ulcer, two occurred in woman, an incidence of about 15 per cent.

Persons with duodenal ulcer are more

anacid, or a very low acidity, is usually present in carcinoma of the stomach.

The use of tight intestinal clamps has

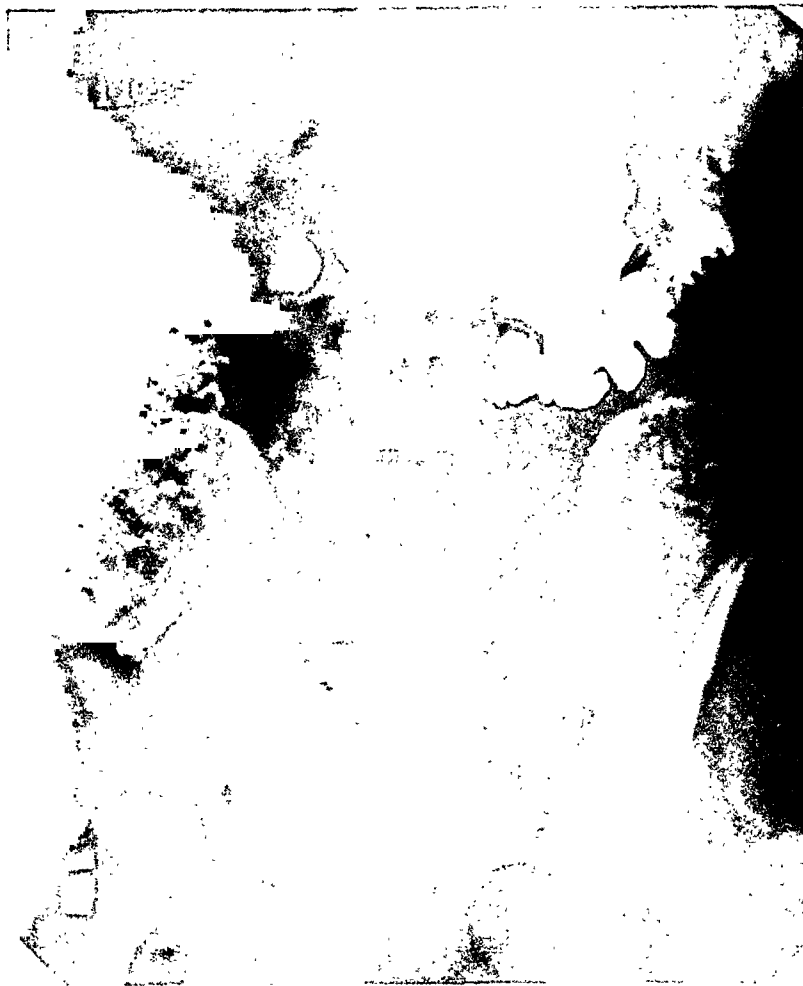


FIG. 2. Case XI. Roentgenogram taken four hours after that shown in Figure 1. Most of the barium in the small bowel has now passed into its distal loops. There is still barium present in the transverse colon at the point of communication with the stomach.

likely to have higher acids than those with gastric ulcer. Gastrojejunal ulcer and fistula are much more common following operations for duodenal ulcer. However, all the blame for these complications cannot be attributed to hyperacidity, for duodenal ulcers are more common than gastric ulcers. Also, ulcers of the stomach are frequently excised or destroyed by cauterization at the time of gastroenterostomy or are removed by partial gastrectomy.

Gastrojejunal ulcer and fistula are practically unheard of in patients in whom gastroenterostomy is done for unresectable carcinoma of the stomach. We know that

been alleged to be a cause of gastrojejunal ulcer. There are many arguments against this hypothesis. We know that the common site for jejunal ulcer is in that portion of the jejunum not gripped by the clamps, and also that the interval between operation and onset of ulcer symptoms may be several years in length. In support of this statement the work of Hurst and Stewart is definitely contributory. They had the opportunity of doing autopsies on 131 patients who had had operations for ulcer. In this group there were forty-six patients who had died within ten days following operation, and none of these had evidence



of jejunal ulcer at autopsy. There were only three jejunal ulcers in a group of forty-one patients who had died from ten

than anterior, gastroenterostomy. This is unfortunate from the technical standpoint, for with the short loop used in the posterior



FIG. 3. Case xiv. Film taken immediately after the ingestion of barium. The gastrojejunocolic fistula is clearly shown. Note the extensive filling of the transverse colon.

days to two months following operation. However, in a group of forty-three patients whose deaths occurred nine months or more after operation, there were twenty-two cases of jejunal ulcer. It is admitted that jejunal ulcer may occur almost immediately after gastroenterostomy, but this is rare.

The theory that non-absorbable suture material is responsible for the production of anastomotic ulcer has been largely abandoned. The complication is still highly prevalent in spite of the use of absorbable materials.

#### PATHOLOGY

When a fistula occurs it is practically always a complication of posterior, rather

type of operation, the inflammatory process in the jejunum may extend well down into the root of the mesentery near the ligament of Treitz, making resection of the fistula very difficult. In the majority of cases reported in the literature the fistulous connection is between the jejunum and the transverse colon. A direct communication between the stomach and colon is uncommon. The location of the fistula varies considerably, but it is usually situated close to the gastroenterostomy and below it. Depending upon the time and mode of perforation of the jejunal ulcer into the transverse colon, there may or may not be extensive adhesion formation.

The mucous membrane which lines the fistulous tract is usually smooth and has a

glistening appearance. Ulceration in the tract is rare, and it has been demonstrated at operation that the formation of fistula

from the colon into the jejunum rather than in the opposite direction. This is due to the fact that the orifice on the jejunal

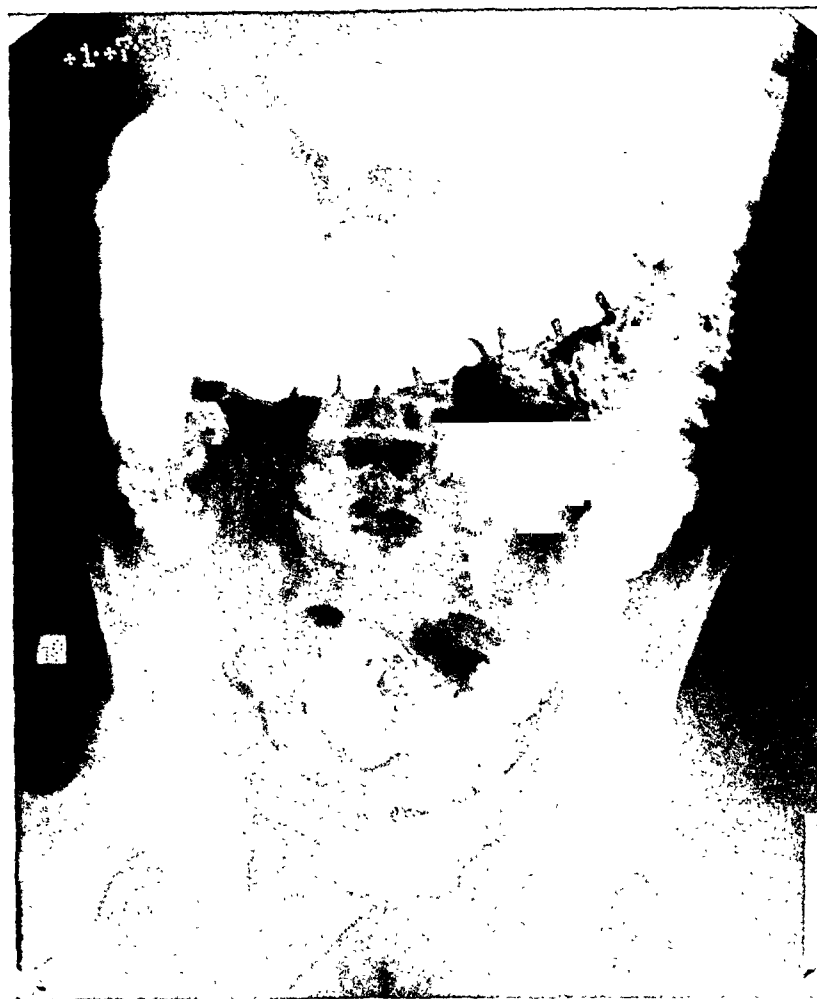


FIG. 4. Case XIII. Post-evacuation film taken about fifteen minutes following introduction of barium per rectum. The fistulous tract cannot be seen in this study, but note the marked filling of the stomach.

has resulted in a cure of the original gastrojejunal ulcer. The absence of an active marginal ulcer is also the rule in cases where the communication between the jejunum and colon is located quite distal to the gastroenterostomy stoma (18 cm. distal to the stoma in one of the cases reported in this study).

The size of the fistula may vary greatly; in the cases presented in this report, the size varied from about 4 mm. to 6 cm. Fistulas are nearly always single, even though there may be multiple gastrojejunal ulcers. In most cases of fistula there is structural evidence that the greater part of the regurgitation which takes place is

side may be located in the folds of mucosa and constitute a valve-like action. This accounts for the relatively low incidence of cases which show undigested food materials in the stools, and for the high incidence of those which have foul eructations. It also helps to explain the intermittent nature of symptoms. Frequently the efferent loop of jejunum is dilated and hypertrophied, probably due to irritation from acid gastric contents and from fecal colon contents. The colon may be constricted at the location of the fistula, and dilated proximal to this point, simulating intestinal obstruction.

## SYMPTOMATOLOGY

*Diarrhea.* The occurrence of a persistent or intermittent diarrhea in a patient who has had a gastroenterostomy for ulcer is the most significant symptom of the presence of a fistula. It is the most common symptom and is frequently the first to appear. It is not unusual for patients with fistula to be treated for ulcerative colitis or dysentery for long periods of time before the correct diagnosis is made. The stools may be watery or semi-liquid; they contain neutral fats and are usually very foul smelling. As stated above, undigested food particles are usually absent; this may be the case even though the fistula be large.

Diarrhea is the manifestation of the disease which is responsible for the emaciated condition of the patient. It is the most difficult symptom to abate, being refractory to medication, though it may be alleviated somewhat by the use of a high residue diet.

Diarrhea was a prominent symptom in all the fourteen cases reported in this study, and the chief complaint of ten patients.

*Vomiting.* Vomiting may occur in patients with fistula, but it is unusual to find actual fecal vomiting. Foul-smelling eructations, on the other hand, occur frequently and are more prevalent during the periods of diarrhea. After the patient has been on a constipating diet for several days, the vomiting and eructations sometimes disappear, recurring with the next episode of diarrhea.

It is interesting to note that in one of our cases (Case VIII), fecal vomiting occurred on the fourteenth day following operation done elsewhere; this type of vomiting occurred intermittently for five and one-half years before the diagnosis of fistula was made and surgical treatment instituted. At operation, it was found that an erroneous anastomosis had been made between the stomach and the transverse colon.

*Pain.* There are no identifying characteristics of the type of pain which accom-

panies fistula. There is a preliminary epigastric pain due to the ulcer itself, but this frequently disappears when the ulcer erodes through to the colon, curing itself. The pain of fistula is usually referred to the colon area, is worse during periods of constipation, and may be relieved by a bowel movement. Severe pain is rare except when there is associated intestinal obstruction.

*Anorexia.* Loss of appetite is an uncommon symptom of fistula, even in patients who have eructations with a feculent odor. It is a significant symptom in patients who are afflicted with fecal vomiting.

*Loss of Weight.* Loss of weight is practically a constant symptom of fistula. It may be tremendous, the patient reaching a marked degree of emaciation, thereby increasing the operative risk. The patient may regain some weight during the periods when the appetite is good and when the diarrhea ceases, but in general pre-operative attempts to increase the weight are discouraging. In this series of thirteen patients with fistula which followed ulcer, one had had a weight loss of 60 pounds, four had lost 40 pounds or more, and three had lost about 30 pounds. Poynton and MacGregor have reported a patient who not only showed a marked degree of emaciation, but who also had an associated nutritional edema of considerable severity.

## PHYSICAL FINDINGS

Evidence of emaciation is the most striking characteristic of patients with fistula. As a rule, palpation of the abdomen reveals nothing significant. A small percentage of patients show a varying degree of distention of either the small or large bowel. Tenderness may be present over a dilated loop of gut. Four of the patients in this study had incisional hernias of moderate size.

## CLINICAL DIAGNOSIS

The classical picture of gastrojejunocolic fistula is that of a history of relief of ulcer symptoms by operation, followed by a

period of recurrent epigastric pain months or years later, and then by a period of intermittent diarrhea with associated foul eructations or fecal vomiting, leading finally to a marked degree of emaciation. The appearance of undigested food materials in the stools very soon after ingestion is pathognomonic of the disease, but this occurs only in the fistulas of large diameter. In those of smaller caliber, various dye stuffs, such as carmine, charcoal, etc., may be useful in demonstrating this rapid passage. Because of the occasional valve-like character of the opening of the jejunal side, a fistula may occasionally be more easily demonstrated with colored enemata.

#### ROENTGENOLOGIC DIAGNOSIS

The roentgenologic aspects of fistulous communication between the stomach and large intestine are spectacular and can scarcely be misinterpreted. Conclusive as they are, however, these signs cannot be observed unless the diagnostic procedures employed are well suited to the situation.

A few technical principles are of prime importance in this connection. If opaque material is seen to leave the stomach by an unusual route, the fluoroscopist should at once apply digital pressure over the point of escape to prevent rapid filling of intestinal loops which would otherwise obscure the finer details of the stomach and proximal duodenum. The initial use of a spoonful of Rugar, or any concentrated barium preparation of high viscosity, is very helpful, particularly if previous gastric surgery is known or suspected, because the time interval between deglutition and initial gastric emptying is definitely prolonged, permitting more leisurely observation.

When any short-circuiting operation has been performed upon the stomach, it is important to determine the degree of residual obstruction at or near the pylorus. Manual obstruction of the operative gastric opening at fluoroscopy is necessary in making such an examination.

If barium can be observed to enter the colon shortly after escaping from the stomach the diagnosis of gastrocolic or gastrojejunocolic fistula may be postulated with certainty. In case folds of mucosa prevent this, subsequent examination at two or five hours may show the abnormal rapidity of passage to the pelvic colon.

If fistula is suspected, an indispensable procedure is the employment of opaque enema after all administered barium has been evacuated. As the barium approaches the mid-point of the transverse colon, its advance should be quite slow. The characteristic patterns of small bowel and gastric mucosa are unmistakable when shown in relief and the contour and size of the gastric lumen are, of course, characteristic. If there is doubt as to the identification of the stomach, the patient's head may be tilted downward, filling the cardiac end. It is seldom that communication between the colon and stomach cannot be demonstrated with ease if this plan is followed.

#### TREATMENT

The treatment of gastrojejunocolic fistula is probably as difficult as that of any surgical condition of the abdomen. Faced, as a rule, with an emaciated patient in poor general condition, who has had one or more gastric operations previously, the surgeon has many obstacles before him which may prevent his obtaining anything better than a fair result. Certainly no routine operation can be applied efficaciously to all fistulas.

In spite of the fact that there is a certain amount of peritoneal immunity established by fistula formation, peritonitis from contamination is still an ever present danger. Harvey Cushing showed many years ago that the contents of the stomach and duodenum were relatively sterile, and that the number of virulence of the various bacteria increased as one passes down the intestinal tract. We know that if perforated peptic ulcers are closed very soon after their occurrence there is little danger of a

severe peritonitis; this is not true with perforations of the colon. It is reasonable to suppose that hydrochloric acid is an important factor in the prevention of growth of pathogenic organisms, for we know that pathogenic organisms do grow in the stomach in cases of carcinoma, a condition in which anacidity is usually present.

The excision or simple closure of the fistula, undoing of the old gastroenterostomy, and reconstruction of the gastrointestinal tract to its normal state have composed the operation which we have used to the best advantage in the majority of our patients. In the presence of pyloric obstruction, obviously a pyloroplasty or some other form of anastomosis will have to be done. For fistulas with extensive inflammatory reaction and adhesion formation, resection "en bloc" may be mandatory. The importance of carrying out any operation in a manner as aseptic as possible goes without saying.

Findlay has recently utilized the Mikulicz procedure, together with pre-operative peritoneal immunization, in a multiple stage operation for gastrojejunocolic fistula, bringing the loop of transverse colon with the attached jejunal stump outside the abdomen. This method may prove to be a substantial contribution in selected cases.

Schrimger has suggested for trial another operation which avoids the extensive resection of the involved portions of the stomach, jejunum, and colon. The essential feature of the operation is the use of denuded cuffs to close the stoma without encroaching upon its lumen. It consists in dissecting off the mucosa and then suturing the muscular walls together, everting the edges as in arterial suture, and using no serosal suture. The operation is applicable chiefly to advanced cases of gastrojejunal ulcer with or without fistula.

Lahey and Swinton, in 1935, suggested the use of an operation which appears to have promise in the treatment of large gastrojejunocolic fistulas by a two-stage

procedure. The method was used in two cases, but it was unfortunate that both patients died, from causes not directly attributable to the operation. Using a left rectus incision, the stomach was cut off proximal to the gastroenterostomy and anastomosed to the jejunum at a location distal to the fistula, the distal end of the stomach then being closed, thereby shunting the gastric contents away from the ulcer and fistula. It was hoped that this might aid in decreasing the inflammatory reaction around the fistula, but autopsies failed to show any such improvement. (One patient had a cardiac death twenty-six days post-operatively; the other died of intestinal obstruction six months after operation.) In retrospect, they feel that it would be worthwhile to attempt resection of the lower end of the stomach, jejunum, and right colon through a right rectus incision about three weeks after the first stage.

The importance of adequate pre-operative preparation of patients with gastrojejunocolic fistula cannot be over-emphasized. Most of them come for treatment in a very poor general condition. The marked loss of weight is accompanied by great alteration in the body chemistry. Dehydration is present in some degree as a result of diarrhea. Alkalosis or acidosis may occur, depending on the amount of chlorides lost by vomiting or the sodium lost by diarrhea. Hypochloremia is to be suspected, and some degree of ketosis is always present as a result of malnutrition. The proper restoration of fluids, salt, and glucose, along with the administration of available vitamins should be carried out until chemical studies assure us that the patient is restored to as near normal as possible before operation is attempted. If this plan is adhered to, the patient will stand an operation of infinitely greater magnitude than if the operation were performed without it.

In most patients, once the diagnosis of gastrojejunocolic fistula is made, we feel that operation is indicated. In some pa-

tients, because of age, absence of severe symptoms, or because of the coexistence of other serious maladies, conservative treatment may be a wiser choice than operation.

#### SUMMARY OF CASES

Fourteen cases of gastrojejunocolic fistula have been seen at the University Hospital during the period from October 1927 to February 1937. Thirteen cases were the result of posterior gastroenterostomy done for duodenal ulcer. One was due to erosion by carcinoma of the stomach which involved a large segment of the transverse colon; no attempt at resection was made.

The average age of the patients studied in this series was 46 years. The youngest patient was 31, the oldest 72. The interval between gastroenterostomy and development of definite symptoms of fistula varied from six months to eleven years, with an average interval of about four and one-half years.

Of the group of thirteen cases resulting from ulcer, ten were operated upon, two of whom died, a mortality rate of 20 per cent. One patient died from peritonitis on the fourteenth day following excision of the fistula, closure of the colon, and resection of the lower half of the stomach and a segment of the jejunum at the site of the fistula. The other death resulted from a lung abscess eighteen days following closure of the fistula and Finney pyloroplasty. In the group of eight patients who survived operation, one died of acute lymphatic leucemia four and one-half years after operation, but had had no symptoms of recurrence prior to death. Two patients had gastrocolic fistula, both treated by simple closure. Six of the patients who survived had jejunocolic or gastrojejunocolic fistula. Four of these were treated by closure of the fistula and disestablishment of the gastroenterostomy; in one of these a Finney pyloroplasty was also done; in another a resection of the involved jejunum was done in addition. Of

the remaining two cases, one was treated by excision of the jejunocolic fistula, the gastroenterostomy being left intact; in the other the fistula was excised and a new gastroenterostomy made. Two patients developed symptoms of reactivated duodenal ulcer, one four months and one six years following operation; both had had a closure of the fistula with reconstruction of the gastrointestinal tract to its normal state. Partial gastrectomy may eventually be necessary in these patients. One patient (Case ix), in whom a new anastomosis had been made, developed a new jejunal ulcer  $3\frac{1}{2}$  inches distal to the stoma; this was treated by resection of the jejunum, leaving her practically asymptomatic three years later.

One patient, because of his age and absence of distressing symptoms was treated conservatively. He lived approximately four years after symptoms of fistula developed.

Two patients refused operation. One died three weeks after leaving the hospital; the other has not been heard from since.

#### SUMMARY AND CONCLUSIONS

Thirteen cases of gastrocolic and jejunocolic fistula following gastroenterostomy for duodenal ulcer are presented in detail. One case of gastrocolic fistula due to carcinoma of the stomach is mentioned briefly.

The various theories pertaining to the development of gastrojejunal ulcer and fistula are discussed. Particular stress is laid upon the importance of hyperacidity as an etiologic factor.

A description of the clinical and pathologic pictures of gastrojejunocolic fistula is presented in some detail.

The salient points in the roentgenologic diagnosis are enumerated.

The difficulties encountered in the treatment of fistula are discussed. Our method of treatment has been presented, together with other recognized operative procedures.

The excision or the simple closure of the fistula, undoing of the old gastro-

enterostomy, and reconstruction of the gastrointestinal tract to its normal state constitute the operation which we have used to the best advantage in the majority of our cases.

We wish to emphasize that, in all patients for whom operation is planned, a careful pre-operative régime designed to restore the body chemistry to as near normal as possible is imperative.

It is our feeling that, in most cases, once the diagnosis of fistula is made, operation is indicated. In some patients, because of age, absence of severe symptoms, or other factors, conservative treatment may be a wiser choice.

#### CASE REPORTS

CASE I. A man, aged 32, was admitted to the hospital October 28, 1927, complaining of vomiting which had been present intermittently for a period of eight months. Fourteen years before entry he developed typical symptoms of peptic ulcer, relieved partially by medical treatment. Gastroenterostomy was done elsewhere in December, 1925. Sixteen months later, he began to have nausea, feculent vomiting, slight abdominal pain, and intermittent diarrhea. He had one hemorrhage, followed by tarry stools for three or four days. He reported a weight loss of sixty pounds.

Examination revealed an emaciated man who was both acutely and chronically ill. Roentgen ray examination demonstrated what was interpreted as a communication between the jejunum and colon.

Operation was done October 29, 1927. A fistula about 4 cm. in diameter was found to exist between the jejunum and transverse colon. It was located just distal to the gastro-jejunosomy. The fistula was isolated and excised, and the opening in the colon closed. The gastroenterostomy was separated and no ulcer was found at the line of anastomosis. The pylorus was closed, probably due to scarring from the old duodenal ulcer. The lower half of the stomach was resected. The jejunum was resected about 4 inches from its origin and reconstructed by an end-to-end suture. The jejunum distal to this was then anastomosed to the stomach according to the method of Polya. The patient was in shock at completion of the operation.

He was given two transfusions following operation and rallied remarkably well. He remained in fairly good condition for a week, when he had a sudden turn for worse, began to vomit, became distended, and rapidly lost ground. Respirations ceased on November 8, 1927. At autopsy it was found that the colon had broken open and drained large amounts of fluid fecal material into the abdomen.

CASE II. A man, aged 49, was admitted to the hospital September 23, 1929, complaining of pain in the upper abdomen following meals. Roentgen ray examination at that time showed no persistent deformity in the stomach or duodenum. The gall-bladder did not visualize by the Graham test. After he failed to improve on conservative treatment, the abdomen was explored. Neither a gastric nor duodenal lesion could be demonstrated, even after opening into the stomach. The gall-bladder was found to be chronically inflamed and was removed. He was well for three years, when he developed persistent vomiting. He presumably had pyloric obstruction, which was treated elsewhere by gastroenterostomy in 1932, which relieved his symptoms for about one year. One year prior to entry he developed an alternating constipation and diarrhea, slight bleeding per rectum, weakness, and some upper abdominal pain.

Examination showed nothing other than the scars from previous operations. Roentgen ray examination demonstrated a satisfactorily functioning gastroenterostomy. There was a fistulous communication between the transverse colon and the small bowel in the region of the gastroenterostomy stoma. Operation was advised, but the patient did not wish to go through with this. He was discharged against advice on November 29, 1934.

CASE III. A man, aged 31, was admitted to the hospital August 29, 1930, complaining of diarrhea of three and one-half years duration. Gastroenterostomy had been done elsewhere in 1920 for duodenal ulcer. He was relieved of ulcer symptoms for about seven years, when the diarrhea developed. This became progressively worse and just before admission he was having from ten to twenty watery stools per day, which resulted in a weight loss of 30 pounds. He had some cramping abdominal pain and a history of food particles in the stool within twenty minutes of ingestion. He also had eructations of fetid gas.

Physical examination revealed a poorly nourished man. The sigmoid colon was palpable and slightly tender. There were no masses felt. Hemoglobin was 97 per cent. Roentgen ray examination demonstrated a communication between the stomach, jejunum, and transverse colon. There was a rapid motility of barium through this fistulous tract. The colon was markedly constricted just proximal to the splenic flexure. Subsequently the patient was given charcoal with a meal; this was recovered in the stool one hour later. Gastric analysis revealed presence of free hydrochloric acid in the stomach.

Operation was advised, but the patient preferred to return home for a few days before submitting to surgery. Discharged September 17, 1930. Communication with relatives revealed that death occurred October 4, 1930.

CASE IV. A man, aged 43, was admitted to the hospital May 4, 1931, complaining of abdominal pain which had been present for about five months. He had had sour eructations, a feeling of fullness, and nausea, but no vomiting. Examination showed a mass in the left upper quadrant which was thought to be spleen. Roentgen ray examination of the stomach and duodenum was negative. The patient refused to remain for further studies at the time of his admission in May, but returned in November with the additional symptoms of diarrhea and fecal vomiting. Roentgen ray examination in November demonstrated an intrinsic lesion on the postero-lateral wall of the stomach and a fistulous connection between the stomach and transverse colon.

Operation was carried out November 28, 1931. Exploration revealed a mass involving the posterior wall of the stomach and about 6 inches of the transverse colon up to the splenic flexure. The tail of the pancreas was also involved in the mass. The lesion appeared inoperable and the abdomen was closed without attempt to resect it. The patient left the hospital on December 9, 1931. Communication from his local physician one month following operation stated that the patient was failing rapidly.

CASE V. The patient, a man 33 years of age, was admitted to the hospital October 9, 1931 complaining of watery diarrhea. Six years before this he had developed typical ulcer symptoms, only partially relieved by medical treatment. Gastroenterostomy was done elsewhere in February 1928 for duodenal ulcer, with

complete relief of symptoms for five months, following which the old ulcer symptoms recurred. In May 1931 he began to have diarrhea, which became progressively worse. There had been a weight loss of 35 pounds. Associated symptoms were nausea, foul eructations, slight pain and abdominal distention.

Physical examination revealed a poorly nourished man. There was some tenderness in the left flank anteriorly. Hemoglobin was 70 per cent. Roentgenologic examination demonstrated a fistulous connection between the stomach and colon at the point of the operative stoma.

Operation was done October 30, 1931. A communication about 3.5 cm. in diameter was found between the jejunum and the colon. There was moderate reaction and adhesion formation around the fistula. Clamps were applied and the jejunum freed from the colon. The gastroenterostomy was undone and no jejunal ulcer was found. The jejunum was reconstructed in a transverse direction to enlarge the lumen. The opening in the stomach was closed. The pylorus had a scar suggestive of old duodenal ulcer. The post-operative course was uneventful and he was discharged on the twelfth day following operation.

He was relieved for six years, then neglected his diet and began to have recurrent epigastric pain, nausea and vomiting. Check-up x-rays (December 22, 1937) demonstrated what was interpreted as a reactivated duodenal ulcer. The patient is having a strict medical program of treatment at the University Hospital at this time.

CASE VI. A man, aged 56, was admitted to the hospital March 6, 1933 complaining of diarrhea which had been present for about six months. Vomiting had been present for about three weeks, never feculent in character, but there was a history of bright red blood in the vomitus two weeks prior to entry. Cholecystectomy and gastroenterostomy (presumably for ulcer) were done in 1929. The weight loss was 40 pounds.

Physical examination was not significant except for evidence of weight loss and a large incisional hernia. Hemoglobin 76 per cent. Roentgen ray examination showed no definite evidence of gastrojejunocolic fistula. There was marked small bowel distention just proximal to the gastroenterostomy stoma.

Operation was done March 14, 1933. A communication was found between the jejunum



and mid-portion of the transverse colon. It was about 2 cm. in diameter and located just distal to the gastroenterostomy. There was little reaction around the fistula. This was isolated and excised and the opening in the colon closed. The jejunum was then repaired by an end-to-end anastomosis.

The post-operative course was uneventful and the patient was discharged on the sixteenth day after operation. He had good health for about three and one-half years when he developed acute lymphatic leucemia. Death occurred November 24, 1937 following an illness of about two weeks.

**CASE VII.** A man, aged 50, was first admitted to the hospital in 1922, at which time a gastroenterostomy was done for gastric ulcer of several years' duration. He was free from symptoms until May 1933 when he began to have a watery diarrhea consisting of three to ten stools daily. He had also been bothered considerably with bleeding hemorrhoids. He was readmitted to the hospital September 4, 1933 with a history of having lost 40 pounds in weight. Other prominent symptoms were foul eructations, sensations of bloating, and extreme weakness.

Examination revealed an emaciated, middle-aged man in no acute distress. The abdomen was thin-walled and slightly distended. He had a moderate secondary anemia which was attributed to bleeding hemorrhoids. Hemoglobin was 45 per cent; red blood cells 2,940,000 per cu. mm. Roentgen ray examination showed the presence of a fistula between the transverse colon and the gastroenterostomy stoma.

The patient was transfused several times before operation and given measures to improve his general condition.

Operation was done September 16, 1933. There was a rather marked inflammatory reaction around the fistula, which was located between the inferior aspect of the transverse colon and the stoma of the gastroenterostomy. The opening in the colon was 6 cm. in diameter, and after being dissected free was closed in a transverse direction. The gastrojejunoanastomosis was severed and the opening in the stomach closed. The opening in the jejunum was closed transversely. The pylorus was occluded, this being treated by a Finney pyloroplasty.

The patient was in good condition for eighteen days following the operation and seemed to be well on the road to recovery when he had a sudden collapse, characterized by marked

weakness, dyspnea, cyanosis and slight chest pain. He died two hours later. Autopsy showed a large abscess of the lower lobe of the right lung which had ruptured into the pleural cavity. There were multiple ulcers in the stomach and jejunum, and evidence of chronic productive peritonitis in the region of the anastomosis, though the peritoneum was smooth elsewhere. Suture lines were intact.

**CASE VIII.** A woman, aged 36, was admitted to the hospital March 27, 1934, complaining of loss of weight, indigestion and vomiting of feculent material. In the early part of 1928, she had had several attacks of severe epigastric pain associated with nausea and vomiting. This was diagnosed as duodenal ulcer and treated by an operation, alleged to have been a gastroenterostomy, done elsewhere in September, 1928. Before the patient left the hospital she was reported to have had fecal vomiting. Diarrhea developed shortly thereafter and continued intermittently, along with the vomiting, up to the time of admission. She had passed definite food particles as soon as two hours after ingestion. Weight decreased from 126 to 71 pounds. Nineteen months before admission she developed carpal spasm, attributed to chloride deficiency, and partially relieved by administration of hydrochloric acid.

Examination revealed a markedly emaciated woman. Blood studies showed a macrocytic anemia, color index 1; hemoglobin 77 per cent; red blood count 3,870,000 cells per cu. mm. Roentgen ray studies demonstrated what was thought to be a gastrocolic fistula.

Operation was done April 5, 1934. An anastomosis was found between the stomach close to the greater curvature and the transverse colon at the junction of its middle and distal thirds. It was obvious that this anastomosis had been erroneously made at a previous operation. Its longest diameter was 5.5 cm. The communication was isolated, clamped, cut with cautery, and the openings in the stomach and transverse colon closed aseptically. The entire length of the jejunum was found to be normal.

Following the operation, the patient developed an acute toxic psychosis which cleared up in about one week. Otherwise her condition was good and she was discharged on the fourteenth post-operative day with instructions to follow a restricted ulcer diet and to receive treatment at home for the anemia.

Three and one-half years after operation the patient was in excellent health. She had doubled her former weight of 71 pounds. The anemia and peripheral neuritis had entirely disappeared.

CASE IX. A woman, aged 55, was admitted to the hospital April 4, 1934. She had had several operations directed toward relief of abdominal pain, all done elsewhere. Cholecystostomy was done in 1926 with partial relief. In 1933 a cholecystectomy and gastroenterostomy were done. The gastroenterostomy did not function well and a second operation, consisting of partial gastrectomy, was carried out while the patient was still in the hospital. Six months following the last operation she began to have abdominal pain, nausea, vomiting, and attacks of watery diarrhea.

Examination revealed an undernourished adult female who was chronically ill. Abdomen was slightly distended. There were four surgical scars in the upper abdomen. No masses or tenderness. Roentgen ray examination showed a definite communication between the efferent loop of jejunum and the transverse colon.

Operation was performed April 10, 1934. Marked adhesion formation made the separation of jejunal coils difficult. The jejunocolic fistula was located about 3 inches distal to the margin of the stomach; it was about 2 cm. in diameter. The opening in the colon was now closed. The stomach was isolated and a new anastomosis made at the aboral angle of the stomach, between it and the jejunum. There was still a sharply angulated loop of jejunum, and in order to obtain better drainage a lateral anastomosis was made between this loop and an adjacent loop of ileum. The post-operative course was surprisingly good, but she was relieved of her symptoms for only six weeks.

The patient returned July 19, 1934 complaining of pain, nausea and vomiting. Roentgen ray examination demonstrated a penetrating jejunal ulcer about 3 inches distal to the gastric stoma. Operation was done the following day and an ulcer  $2\frac{1}{2}$  inches in diameter found in the greater curvature of the stomach at the site of its union with the jejunum. The floor of the ulcer was the colon. The upper 8 inches of the jejunum were now resected and an anastomosis made between the superior end of the jejunum and the stomach. Except for a wound infection, the post-operative course was quite good. She was discharged the nineteenth day after operation. Communication with the patient three

years later revealed that she was getting along nicely, having no symptoms except occasional nausea.

CASE X. A man, aged 62, was admitted to the hospital, May 15, 1934, complaining of persistent vomiting and diarrhea. Gastroenterostomy had been performed elsewhere four years ago for ulcer. Symptoms were relieved until about six weeks prior to admission, when a severe watery diarrhea developed rather suddenly and became progressively worse. Vomiting had been present for two weeks and was of feculent nature just before entry. A weight loss of 41 pounds was reported.

Examination revealed an elderly man in poor general condition and quite emaciated. There were no significant abdominal findings. Hemoglobin was 83 per cent; white blood count 21,600. Roentgen ray examination of the upper gastrointestinal tract showed a normally functioning gastroenterostomy with no evidence of marginal ulcer. Barium enema revealed a fistulous opening between the small bowel and the proximal transverse colon.

Operation was done May 25, 1934 following several days hydration and general supportive treatment. On opening the abdomen, extensive adhesions were encountered and severed. A fistula was found between the mid-point of the transverse colon and the jejunum at a point about 18 cm. distal to the gastroenterostomy stoma. The opening was 3 cm. in diameter and there was little reaction around it. The fistulous tract was isolated, clamped and excised. The openings in the jejunum and transverse colon were closed transversely.

The patient had a fairly stormy post-operative course which was complicated by a mental upset and a wound infection, both of which cleared up. He was discharged home on the thirty-third day following operation. A letter from the patient's home physician on December 22, 1937 revealed that he had been practically asymptomatic ever since operation, but had had vague epigastric pain for the last four weeks. He had been on a #4 Mills diet ever since operation.

CASE XI. The patient, a man, aged 36, came to the hospital November 11, 1935, complaining of diarrhea and vomiting. Thirteen years before admission he had had a perforated peptic ulcer closed elsewhere, at which time a gastroenterostomy was also done. A year later, he developed a jejunal ulcer, proved by x-ray. This was treated fairly satisfactorily for four

years by dietary methods. For three years prior to admission he had had intermittent watery diarrhea which became progressively worse. Vomiting had occurred irregularly for three months and had recently been of feculent character. The weight loss was 32 pounds.

Physical examination revealed nothing significant except emaciation. Hemoglobin was 86 per cent. Roentgen ray examination showed a freely functioning gastroenterostomy and a fistulous connection between the jejunum and transverse colon to the left of the midline.

Operation was performed November 11, 1935. There was a definite fistula between the jejunum and the transverse colon, located about 3 cm. distal to the gastroenterostomy. The fistula was about 3 cm. in diameter. This was isolated, clamped, cut and the opening in the colon closed. The gastroenterostomy was disconnected, but no evidence of jejunal ulcer could be found. The opening in the stomach was closed. The jejunal openings were both closed transversely and omentum drawn over them. Post-operative course was without event and the patient was discharged on the thirtieth day following operation.

The follow-up on December 13, 1937 revealed that he had been asymptomatic ever since operation. He had had a gain in weight of 65 pounds and was working daily in a machine shop.

**CASE XII.** A man, aged 72, was admitted to the hospital November 4, 1935 complaining of abdominal pain, slight weight loss and alternating constipation and diarrhea. The diarrhea was not severe. Operation for peptic ulcer had been done some years previously, exact date unknown. He had been relieved until two years before entry, when the above symptoms developed.

Examination revealed an elderly man in an undernourished condition. There was an upper midline scar and a questionable mass in the left lower quadrant. Roentgen ray examination demonstrated a gastrojejunocolic fistula at about the mid-portion of the transverse colon.

Because of the patient's age, it was decided to treat him conservatively. He was discharged on a high caloric diet, avoiding food which gave him particular distress. Death occurred at his home about nineteen months later, following a downhill course.

**CASE XIII.** A man, aged 40, was admitted to the hospital January 5, 1937, complaining of watery diarrhea of two years' duration. Fifteen

years before entry, he had developed typical symptoms of peptic ulcer, and seven years later, following a period of persistent vomiting, gastroenterostomy was performed elsewhere for pyloric obstruction. He was relieved for about six years, when the diarrhea developed. He lost about 30 pounds in weight but gained considerably during a period of three months prior to entry.

Examination revealed a fairly well nourished adult male. Abdominal findings were not contributory. Roentgen ray examination demonstrated a definite communication between the stomach and transverse colon at the gastroenterostomy stoma. The duodenal bulb was deformed by scar.

Operation was done January 11, 1937. There was scarring from the old duodenal ulcer. The stomach was freed from its connection with the jejunum and the site of anastomosis was then cut away. The opening in the jejunum was then closed transversely.

The patient's course following operation was without significant event and he was discharged on the eighteenth post-operative day. He returned four months later with symptoms of reactivated duodenal ulcer. He was relieved temporarily after two weeks treatment with a Sippy diet. Since then he has had intermittent ulcer symptoms.

**CASE XIV.** A man, aged 52, was admitted to the hospital January 25, 1937, complaining of diarrhea. He had had a known duodenal ulcer for fifteen years, which was treated elsewhere by gastroenterostomy eleven years prior to admission, with relief for eighteen months. Two years following operation he developed a persistent diarrhea, the cause of which was subsequently found to be a gastrojejunocolic fistula. This was also operated elsewhere with complete relief of symptoms for nine years, when the diarrhea again appeared.

Physical examination at the time of admission was not significant. The patient was slender, well developed and in fair general condition.

Roentgenologic examination revealed a slowly functioning gastroenterostomy. A definite fistulous connection was demonstrated between the small bowel at the site of anastomosis and the transverse colon, distal portion.

Operation was done January 27, 1937. The transverse colon was found to be closely adherent to the jejunum immediately beneath

the gastroenterostomy stoma, which was patent. A fistula about 1 cm. in diameter connected the jejunum and colon. There was still slight scarring from the old duodenal ulcer. The gastroenterostomy was disconnected and the jejunum separated from the colon, the latter being closed transversely. The openings in the stomach and jejunum were then closed and a Finney pyloroplasty done.

Post-operative distention was treated with continuous gastric suction for three days. The development of a wound infection delayed recovery. However, he was discharged on the twenty-sixth post-operative day in good condition.

The patient returned to the hospital on April 7, 1937 because of severe cardiospasm which was relieved without event by esophagoscopy.

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RUPTURE of the diaphragm is uncommon. It may be produced by a sudden increase in abdominal pressure as the result of crushes or muscular efforts in vomiting or parturition. It is usually on the left side, and cases have occurred where the rupture has been produced by an esophageal bougie.

From—"The Science and Practice of Surgery" by W. H. C. Romaines and Philip H. Mitchiner, 6th Ed. (Churchill).

# PRIMARY CARCINOMA OF THE DUODENUM\*

## WITH A REPORT OF ELEVEN CASES

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THE rarity of carcinoma of the duodenum has been repeatedly emphasized. While it is not common, the fact that eleven cases were diagnosed in this clinic in the last ten years and that similar experiences have been reported in other clinics, should remove it from the list of diseases thought hardly to exist and place it among those for which some more generally accepted attempt should be made at a diagnosis and cure.

It has been reported by Eger<sup>1</sup> and confirmed by others, that carcinoma of the duodenum is found in approximately 0.03 per cent of a large series of autopsies. During the time of appearance of our eleven cases, 154,613 patients were seen. This means that one case occurred for approximately each 14,000 admissions to the clinic.

The accepted rarity of the condition has resulted in too little attempt being made at diagnosis and perhaps, as suggested by Eger, in a lack of decision on the part of the operator when the condition is unexpectedly encountered.

These tumors may occur in any portion of the duodenum, but are much more prevalent in the region of the papilla of Vater.

If we may consider these eleven cases as representative, a careful analysis of them should give an accurate picture of the condition. The first six cases have previously been reported by Mateer and Hartman.<sup>2</sup>

### CASE REPORTS

CASE I. S. R., a male, 44 years of age, was admitted to hospital May 26, 1930. He complained of: weakness for five months; jaundice and pain in right upper quadrant for four

months; and the loss of 27 pounds in five months.

*Physical examination* showed moderate jaundice; evidence of loss of weight; the liver enlarged three fingerbreadths below the costal margin. X-rays of the stomach and duodenum were negative, but the stool was positive for occult blood.

The pre-operative diagnosis was acute exacerbation of chronic cholecystitis, probably with stones.

*Course.* After a period of preparation, operation was done on June 26, 1930, and a large distended gall-bladder was found. Because of the patient's poor condition a cholecystostomy only was performed, with a second operation seven weeks later when the patient's general condition had improved. The gall-bladder was removed and the common bile duct was found to be greatly enlarged. A mass, believed carcinomatous, was found, in what was thought to be the head of the pancreas, surrounding the terminal portion of the common bile duct. The common bile duct was drained. The patient died ten days after operation.

*Post-Mortem Examination.* At the autopsy the following features were observed: (1) a mixed squamous cell and adenocarcinoma of the ampulla of Vater and the duodenum; (2) metastatic carcinoma in the regional lymph glands, liver and pancreas; (3) obstruction of the pancreatic and common bile duct.

The tumor of the ampulla was a friable mass which extended through the papilla onto the surface of the duodenum as a flat granular tumor 2 cm. in diameter.

*Comment.* This condition was thought at operation to be primarily a carcinoma of the pancreas, but the diagnosis was proved by autopsy to be a mistaken one. The inoperability was demonstrated.

CASE II. M. B., a female 62 years of age, was admitted to hospital July 17, 1930, with complaints of jaundice and pain in the right

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upper quadrant and epigastrium of three months' duration; weight loss of 25 pounds in three months, associated with anorexia and occasional vomiting.

On examination, the patient was thin, emaciated, jaundiced and weak. The liver was palpable four fingerbreadths below the right costal margin. Rectal examination revealed a palpable mass which was diagnosed as an adenocarcinoma, type 1, following biopsy. X-rays of the stomach and duodenal cap were negative.

*Course.* It was considered that the enlargement of the liver and biliary obstruction were due to a metastatic carcinoma from the rectum and that the condition was inoperable. The patient was, therefore, discharged from the hospital. She was readmitted one month later in extremis, and died the following day.

*Post-mortem examination* showed: (1) adenocarcinoma of the papilla of Vater with obstruction of both pancreatic and bile ducts; (2) metastatic carcinoma of the mesenteric and retroperitoneal lymph glands; (3) metastatic carcinoma of the liver and lungs; (4) papillary adenocarcinoma of the rectum.

*Comment.* This patient's condition was considered inoperable and this was proved to be true at autopsy. The presence of an adenocarcinoma of the rectum, coincidental with the carcinoma of the papilla complicated the diagnosis.

*CASE III.* E. H., a female of 63, was admitted to hospital December 13, 1930, complaining of loss of 80 pounds in four or five months; anorexia, nausea and vomiting for seventeen days; pain in the lower quadrants of abdomen.

Examination of the patient showed a moderate jaundice. She was obviously in extremis, had generalized abdominal tenderness, and showed obvious loss of weight. Her white blood count was 24,500. The diagnosis made was probable generalized carcinomatosis with acute generalized peritonitis.

*Course.* The patient's condition permitted neither further studies nor operation and she died the day following admission.

*Post-Mortem Examination.* *A u t o p s y* showed: (1) acute generalized peritonitis secondary to rupture of gall-bladder; (2) chronic cholecystitis and cholelithiasis; (3) chronic interstitial pancreatitis; (4) adenocarcinoma

of the papilla of Vater. No metastatic tumor was found.

*Comment.* No more definite diagnosis could be made in the case of this patient than generalized peritonitis, since her poor condition did not permit any type of operation. The carcinoma of the duodenum was simply an interesting autopsy finding.

*CASE IV.* G. M., female, 52 years of age, was admitted to hospital December 29, 1930. Two and a half years previously she had had a cholecystectomy elsewhere because of what was diagnosed as gall-bladder colic accompanied by jaundice and a loss of 110 pounds. A little over a year later a second operation was done elsewhere, and a mass in the terminal portion of the common bile duct was found. This was removed and the bile duct was anastomosed to the duodenum. On admission she complained of tightness of the epigastrium which had been present for five months; anorexia of three months' duration, vomiting which had been present for a few weeks; loss of 10 pounds in the preceding thirty days. She had upper abdominal discomfort with the vomiting but had noted no jaundice.

A firm mass could be felt in the right upper quadrant of the abdomen extending down to the level of the umbilicus. There was obvious weight loss. X-ray examination of the stomach showed a slight irregularity in the antrum and the duodenal cap did not fill well. Fluoroscopically and on all the films there was also noted a narrowing of the duodenum. There was persistent occult blood in the stool.

A diagnosis of probable carcinoma of the duodenum in an inoperable stage was made. This was based on the history, clinical findings, the x-ray defect in the duodenum and persistent blood in the stool.

*Course.* The patient left the hospital and returned three months later because of vomiting, blood in the stool, and jaundice. She gradually failed and died two months later.

At post-mortem examination the following were noted: (1) primary adenocarcinoma of the papilla of Vater; (2) regional, mesenteric and retroperitoneal metastatic adenocarcinoma; (3) hemorrhage into the intestinal tract from the tumor; (4) multiple abscesses of the liver.

*Comment.* A diagnosis of probable carcinoma of the duodenum in an inoperable stage was made. Five months later this

patient died and autopsy revealed an inoperable condition. It is of some interest to speculate as to when during this patient's more than

X-ray examination showed the stomach to be negative, but there was stasis in the second portion of the duodenum with dilatation proxi-



FIG. 1. Case XI, x-ray showing filling defect in duodenum.

two and one half year illness the carcinoma developed.

CASE V. H. S., a male 71 years of age, was admitted to the hospital July 24, 1931. He had been operated on elsewhere three months previously because of gallstones, cholecystostomy being done. Previous to that for three or four years he had had dull right upper quadrant discomfort. Since his operation his discomfort persisted. He had black tarry stools at times; weakness; anorexia and weight loss.

Upon examination there was evidence of weight loss. A large palpable mass in the right upper quadrant lay directly beneath the scar of the previous operation. There was rather marked anemia, the hemoglobin being 41 per cent. There was occult blood in the stools.

mal to this; there was still retention of barium in the stomach after six hours. Carcinoma of gall-bladder was diagnosed.

*Course.* At operation a large mass, involving the duodenum and gall-bladder and considered to be in an inoperable stage, was found. There were nodules in the liver. A portion of one of these was removed and found to be metastatic carcinoma. The patient died four days following the operation.

*Post-Mortem Examination.* The findings were: (1) adenocarcinoma of the duodenum 13 cm. below the pylorus and 4 cm. below the papilla of Vater, a large crater-like ulcer 6 cm. in diameter extending directly into the head of the pancreas; (2) metastatic carcinoma of the pancreas, regional and retroperitoneal lymph glands, the liver and both lungs.



*Comment.* A completely inoperable condition was found at operation. Here especially, the persistence of tarry stools following the drainage of the gall-bladder should have been

whitish nodules in the liver. Biopsy from the liver revealed the presence of metastatic carcinoma. The condition was inoperable. The patient died on the ninth post-operative day.

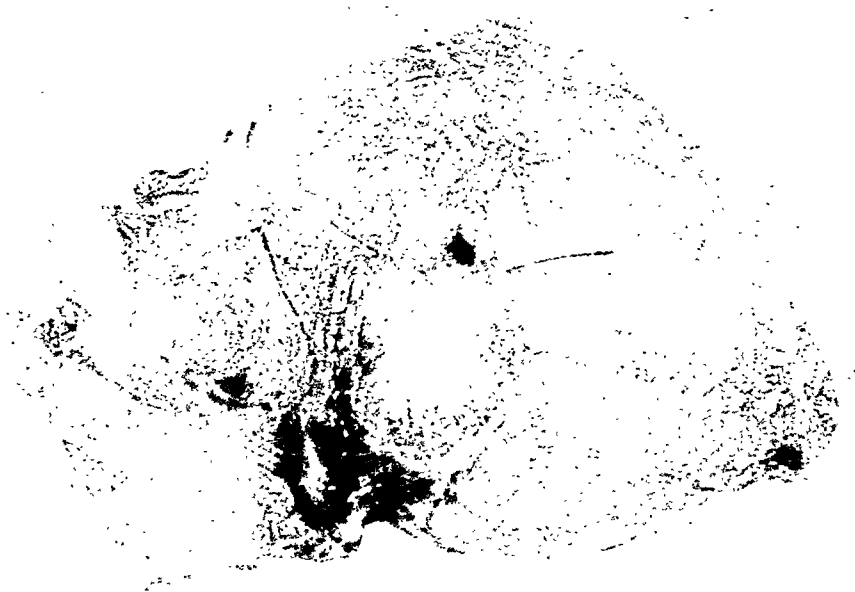


FIG. 2. Case XI, showing the unopened portion of the duodenum which was removed.

the clue to the discovery that the trouble had not been corrected. The diagnosis of carcinoma of the duodenum should have been made rather than a diagnosis of carcinoma of the gall-bladder.

**CASE VI.** W. A., male age 64 years, was admitted to hospital November 24, 1931. He had had epigastric pain at intervals of a few months for one and a half years. This had been more persistent during the preceding two months. Recently nausea without vomiting began to accompany the discomfort. There had been a loss of 8 pounds in three weeks.

*Examination.* Revealed slight jaundice; hemoglobin of 80 per cent; stools positive for occult blood; liver edge palpable three finger-breadths below the right costal margin. X-ray of the stomach and duodenal cap was negative. The pre-operative diagnosis was biliary obstruction probably due to a carcinoma of the ampulla.

*Course.* Operation was done on December 9, 1931. A hard firm mass was found in the region of the terminal portion of the common bile duct and the head of the pancreas, with greatly enlarged lymph glands about the cystic and common duct. There were multiple hard

*Post-Mortem Examination.* In the first portion of the duodenum, 6 cm. below the pylorus and 2.5 cm. above the papilla of Vater, was a circular ulcerated excavation in the wall which extended into the head of the pancreas. In the base of this an eroded blood vessel was found. This was diagnosed as adenocarcinoma. There was also metastatic carcinoma of the liver, pancreas and regional lymph glands.

*Comment.* An inoperable condition was found following the making of an essentially accurate diagnosis. In those cases with the tumor located as in this case, in the first portion of the duodenum, the best chance for removal exists. An early diagnosis before metastases have occurred is imperative.

**CASE VII.** M. S., female aged 36 years, was admitted to the hospital August 2, 1927. During the preceding year she had two attacks of right upper quadrant discomfort with associated jaundice. The second attack began six months before her admission and persisted until admission. She had had frequent nausea and vomiting during the preceding six months. There was a weight loss of 30 pounds during the year.

Examination revealed loss of weight, moderate visible jaundice, non-filling gall-bladder on

cholecystograms. The stools were positive for occult blood. Chronic cholecystitis with stone in the common duct and partial intestinal obstruction of undetermined cause were diagnosed.

75 per cent. No B bile was obtained on trans-duodenal biliary drainage. X-ray of the stomach and duodenal cap was negative; x-ray of the second portion of the duodenum showed some

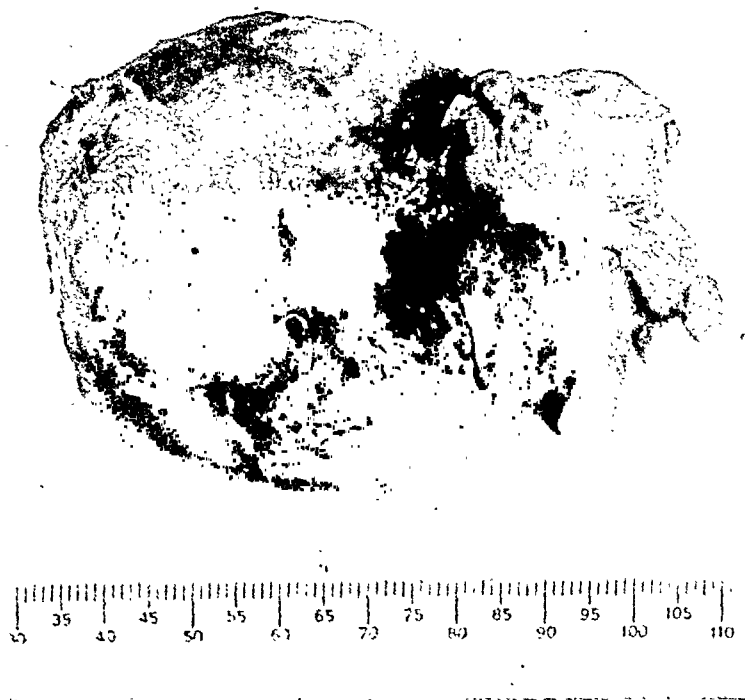


FIG. 3. Case XI, showing the opened specimen with the tumor in profile.

*Course.* The patient continued to vomit. After a period of preparation she was operated on (8/13/27). A large mass was found in the transverse colon which seemed to ascend from the mesentery into the wall. The condition was considered inoperable, but a palliative ileostomy was done. The patient died on the eighth post-operative day.

*Post-Mortem Examination.* Autopsy showed: (1) adenocarcinoma of the papilla of Vater with bile duct obstruction; (2) metastatic carcinoma of the transverse colon and ileocolic lymph glands.

*Comment.* The partial obstruction of the large intestine, as a result of the metastatic tumor, confused this picture. The condition had reached an inoperable stage.

CASE VIII. F. M., a male of 53 years, was admitted to the hospital February 24, 1933. He had had jaundice of four weeks' duration, pain in the upper abdomen intermittently for two months. There was a loss of 35 pounds in three months. Other complaints were anorexia, nausea and vomiting intermittently for six to eight weeks.

Examination showed obvious weight loss and moderate jaundice. The hemoglobin was

irregularity. The stools were positive for occult blood. The pre-operative diagnosis was obstructive jaundice, probably due to cholelithiasis. A diagnosis of carcinoma of the duodenum or head of the pancreas was considered.

*Course.* The patient was operated on on March 3, 1933. Gallstones were found in an enlarged gall-bladder, which was removed. Palpation of the terminal portion of the common bile duct revealed what was thought to be induration in the head of the pancreas. A piece of tissue was removed for microscopic examination and this revealed a normal pancreas.

The patient did satisfactorily for a few days, but died on the seventh post-operative day following a massive intestinal hemorrhage.

*Post-mortem examination* revealed: (1) adenocarcinoma (type 2) of the duodenum at the papilla of Vater with obstruction of the common bile duct; (2) also a hemorrhagic pancreatitis.

*Comment.* The pre-operative examination of this patient resulted in a secondary diagnosis of possible carcinoma of the duodenum. This was based upon the irregularity of the second portion of the duodenum in the x-ray examination, the occult blood in the stool and the

obstructive jaundice. At operation this was borne in mind and palpation failed to reveal presence of the tumor except for the finding of

condition had reached an inoperable stage and a palliative gastroenterostomy was done. This patient was discharged on June 29, 1933. She

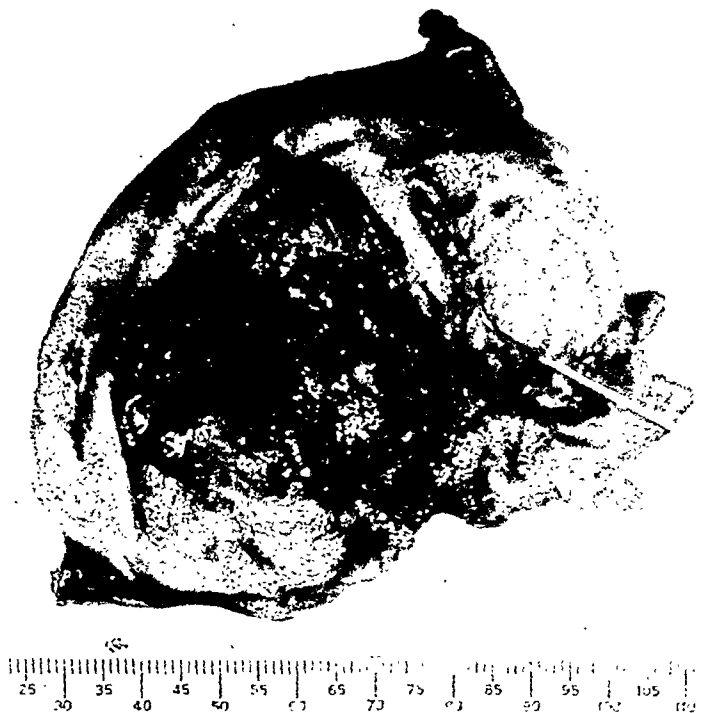


FIG. 4. Case XI, showing the opened specimen with a probe passed through the papilla at the upper border of the tumor.

induration in the head of the pancreas. The correct diagnosis could have been arrived at by transduodenal examination of the region of the papilla.

**CASE IX.** A. D., a female of 71, was admitted to the hospital May 26, 1933. Her complaints were upper abdominal pain and distress for the past year, which had become worse for the preceding two months; weakness; anorexia and occasional nausea for two months; induced vomiting for two months.

There was a greatly enlarged stomach with almost 100 per cent retention at the end of six hours. The duodenum was not visualized. The stool was positive for occult blood. The pre-operative diagnosis was a probable carcinoma of the pylorus with obstruction.

**Course.** The patient was operated on June 1, 1933. An infiltrating growth involving the wall of the duodenum and obstructing it was found at a point 3 cm. below the pylorus. A biopsy from a nodule in the liver was diagnosed as a metastatic adenocarcinoma, type 2. The

died at her home on February 18, 1934, approximately eight and one-half months after her operation.

**Comment.** Metastases were present in the liver and the condition therefore was inoperable except for the palliative gastroenterostomy. The non-visualization of the duodenum might have suggested the correct diagnosis. The closeness of the tumor to the pylorus resulted in perhaps excusable error.

**CASE X.** E. H., male, aged 37 years, was admitted to the hospital December 4, 1935. He complained of discomfort in the right upper abdomen present intermittently for six months, accompanied by heart burn; loss of 20 pounds in six months, accompanied by increasing weakness; jaundice of three weeks' duration; intermittent diarrhea for the preceding two weeks.

There was obvious weight loss, moderate visible jaundice. Stool examination revealed the presence of occult blood. X-ray examination revealed narrowing and irregularity in the third portion of the duodenum. No B bile was

obtained on transduodenal biliary drainage. Hemoglobin was 66 per cent. Possible carcinoma of the duodenum, was diagnosed, based on the x-ray findings, the presence of occult blood in the stool, the history, the biliary drainage findings and jaundice studies.

*Course.* Following a period of preparation, the patient was operated on December 16, 1935. The gall-bladder and common bile duct were found to be greatly enlarged. A large tumor mass involving the duodenum and extending from the region of the papilla down to the junction of the second and third portions was palpated. The growth did not completely surround the duodenum but nevertheless caused marked obstruction. There were multiple nodules in the pancreas.

The duodenum was opened for about one and one-half inches to allow visual examination. A large tumor mass involving the posterior wall of the duodenum in the region of the papilla and extending downward from it could be seen and felt. A small portion of the tumor was taken for microscopic examination and was diagnosed as adenocarcinoma, type 2. A cholecystenterostomy was done, it being considered that the condition was inoperable and that probably a gastroenterostomy would be needed later. However, the patient died on the fifteenth post-operative day as a result of pneumonia.

*Comment.* A correct pre-operative diagnosis was made, but the condition was deemed inoperable on exploration of the abdomen. The diagnosis was definitely made by transduodenal exploration and biopsy. This is probably the only way that a correct diagnosis may be arrived at at operation.

CASE XI. L. P., male, aged 47 years, was admitted to the hospital August 13, 1937. He had had stomach trouble for one year, with a weight loss of 22 pounds. Right upper quadrant pain had been present for 3 days. During the preceding year he had several attacks of diarrhea with light colored stools, abdominal distress and generalized weakness.

Examination showed muscle spasm in the right upper quadrant of abdomen, liver dulness 4 cm. below the right costal margin. The hemoglobin was 70 per cent. The temperature was normal. The stools were positive for occult blood, and the icterus index was 9. X-ray examination of the stomach and duodenal cap was normal; the gall-bladder showed non-filling on cholecystograms. A pre-operative diagnosis of chronic cholecystitis was made.

*Course.* Cholecystectomy was done on August 31, 1937, operation having been postponed because of the development of fever and tenderness in the region of the right kidney. The gall-bladder was found to be distended, the walls moderately thickened. No stones were present. It should be noted that the stomach and duodenum were palpated for the presence of ulcer and none was found. Except for an unusual amount of post-operative vomiting for a period of ten days, convalescence was uneventful. The patient was discharged from the hospital September 18, 1937.

Following this he continued to vomit at intervals of a few days and on October 22, 1937, there was visible gastric peristalsis. At this time he gave a history of having recently vomited food that he had eaten the day before, that he had lost an additional 12 pounds, and that he continued to have colicky abdominal pain. He was again admitted to the hospital on October 25, 1937. On admission 2600 c.c. of fluid and food were aspirated from the stomach. X-ray examination on the day following admission revealed a large hypotonic type of stomach. The duodenal cap was large and well filled, but there appeared to be an obstruction in the second or third portion of the duodenum resulting in 100 per cent retention of barium. Because of these findings a diagnosis of probable malignancy of the duodenum was made. Following a period of preparation a second operation was done on October 28, 1937. Because of the above findings the duodenum was mobilized to permit adequate palpation and when this was done a tumor mass could be palpated in the duodenum below the level of the papilla and entirely separate from the pancreas. A radical resection was done by Dr. R. D. McClure. It was at first felt that the tumor was well below the point of entrance of the common bile duct, but it was eventually determined that it was so close that resection of the duct was necessary. This was therefore done. The duodenum was cut across about 3 cm. above and below the tumor mass, 11 cm. of the duodenum being removed. It is of interest to note, in the light of subsequent events, that a careful search was made for the pancreatic duct but it could not be visualized nor could it be found on the specimen which was removed. The stumps of the duodenum were inverted and held in place by mattress sutures of fine silk. A choledochgastrostomy and posterior gastroenterostomy were done. A stab wound was made in the right flank and a cigarette

drain was brought out through this from the region of the resection.

The patient's post-operative course was unusually smooth for so involved a procedure. On the day following the operation, however, there began to be a rather profuse drainage through the wound in the flank. This was collected by inserting a tube in the wound, the amount averaging from 500 to 600 c.c. daily. It contained trypsin and lipase and obviously was almost pure pancreatic secretion. During the subsequent period an attempt was made to reintroduce this pancreatic secretion along with his food, but this was only partially successful. The patient refused the food which contained the secretion after a period of about two weeks. During this time he was also given pancreatin.

On two occasions total fat determinations were made of twenty-four-hour stool specimens, in each instance with the patient on a diet calculated to contain 100 Gm. of fat. One determination revealed 0.29 Gm. and the other 2.4 Gm. of fat residual in the stool.

The patient's appetite remained very poor and, because he seemed to be gradually failing and the drainage from the pancreatic fistula remained at a high level, he was again operated on by Dr. McClure on December 15, 1937. It had been originally thought that an attempt would be made to transplant the pancreatic fistula. He was doing so poorly, however, that it was decided that something must be done before the fistulous walls were sufficiently strong to permit transplantation. In view of Dr. Whipple's<sup>3</sup> reported success with ligation of the pancreatic duct it was felt that it might be possible to find this and ligate it even though attempts to find it before had been unsuccessful. At operation the head of the pancreas could easily be brought into view but the duct was not seen. Scattered over the surface of the transverse colon and of the adjacent mesentery were flat, whitish growths of tumor tissue, one of which was removed from the mesentery and reported as being composed of the same type of cell as the original duodenal tumor. These implantations were almost innumerable but no evidence of other metastatic tumor was found. Failing to visualize the pancreatic duct a double ligature of heavy silk was placed around the head of the pancreas with an aneurysm needle about  $1\frac{1}{4}$  inches from its right sided termination. This was tied snugly. There resulted an almost complete cessation of drainage from the fistula for the

first day following operation, and after this there remained a marked diminution of drainage, it being only about 200 c.c. daily. He was discharged from the hospital on December 23, 1937, and has since been followed at his home. The amount of drainage gradually decreased to a few cubic centimeters daily.

Pathologic examination of the tumor removed resulted in a diagnosis of medullary carcinoma. On opening the resected portion of the duodenum, there was found a hard area in the wall just below the papilla, about 3 cm. in diameter, raised from the surrounding mucosal surface. The surface of this tumor mass was superficially ulcerated in part and covered with typical mucosa in the remaining area. Sections through the tumor showed involvement of the entire duodenal wall to the serosal coat. The tumor was composed of a delicate reticulum, between the strands of which tumor cells of widely varied size and shape and staining characteristics were lying. Only occasional mitotic figures were seen. There was apparently no attempt at glandular formation and the cells appeared to be growing in single irregular columns. Sections were stained with silver and trichrome stain and none of the tumor cells showed any argentaffine characteristics.

*Comment.* The first diagnosis of chronic cholecystitis seemed reasonably well justified by the findings on physical examination, the history and the non-filling gall-bladder on the cholecystograms. The presence of the occult blood in the stool was, of course, not the result of the chronic cholecystitis. The very fact that this patient's duodenum was carefully palpated and the tumor not found at the first operation is illustrative of the difficulty of diagnosis. The second x-rays, taken when the obstruction was more severe, clearly showed the duodenal defect and assisted in accurate diagnosis. The unusual type of cellular structure of this tumor is of considerable interest.

#### COMMENT ON THE ELEVEN PATIENTS

These patients represent an age distribution from the fourth to the eighth decades. The sex distribution is of no significance, there being six males and five females in the group.

The tumors were located as follows: Suprapapillary area, two cases; papillary

area, seven cases; and infrapapillary area, two cases. The predominance of tumors in the region of the papilla is in accordance with the findings of others.

*Symptoms.* All patients complained of abdominal pain which varied from mild distress to severe colic, and in almost every instance there were additional complaints of anorexia, weight loss, nausea, vomiting, and, in seven instances, jaundice. Obviously these complaints would lead to no more definite conclusion than that the patient probably suffered from a disease of the gastrointestinal tract, and in some instances of biliary obstruction.

*Examination.* The examinations of these patients almost uniformly revealed evidence of weight loss. One patient was obese. There was a palpable mass in the right upper abdomen in two instances. The stools were positive for the presence of occult blood in the ten instances in which this examination was done. Seven of the patients were jaundiced. In all instances x-ray examinations of the stomach were negative and in four instances only were duodenal defects noted. Some of these patients had a fairly marked secondary anemia and with others it was only moderate.

*Diagnoses.* The pre-operative or ante-mortem diagnoses arrived at were as follows: (1) carcinoma of duodenum, 2 cases; (2) carcinoma of ampulla or head of pancreas; (3) carcinoma of gall-bladder; (4) generalized peritonitis and carcinomatosis; (5) metastatic carcinoma of liver from carcinoma of rectum, the latter condition being proved; (6) gall-bladder disease with obstructing stones, three cases; carcinoma of duodenum was considered in one case; (7) chronic cholecystitis; (8) carcinoma of pylorus with obstruction.

A study of our own and of reported cases leads one to the conclusion that a pre-operative or ante-mortem diagnosis may be arrived at in most instances by the exclusion method only. A filling defect on the x-ray film of the duodenum should be of the greatest help, but often is not visualized. Perhaps more careful attention to the

duodenal area and more frequent films would result in more positive diagnoses as suggested by Startz.<sup>5</sup> Herman and Von Glahn<sup>6</sup> have pointed out that the finding of an approximately normal gastric acidity in a patient who might otherwise be thought to have carcinoma of the stomach should make one very suspicious of the presence of carcinoma of the duodenum. This fact may be of considerable value in differentiating the two conditions when the x-ray examinations are inconclusive.

In those instances where the tumor results in biliary obstruction, the differential diagnosis between duodenal tumor, tumor of the pancreas and common duct stone is difficult. All three conditions may produce jaundice, pain, anorexia, nausea, vomiting and weight loss. Pain is much less common with the pancreatic tumors. Deformities of the duodenum on the x-ray film, of course, favor a diagnosis of tumor of the duodenum. The presence of occult blood in the stool would greatly favor the diagnosis of intestinal tumors and is probably the most valuable sign of all. The diagnosis and the differential diagnosis of infrapapillary duodenal tumors from those lower in the intestinal tract, can be made to a certain extent from the clinical picture, but the most reliable aid will be the x-ray filling defects.

*Operations.* Of the eleven cases, three were rightly considered inoperable. The remaining eight were operated upon. In two the tumor was not found at operation, cholecystectomies being performed. In five cases the masses involving the duodenum and adjacent structures were palpated, but the condition was considered inoperable because of metastasis to the liver in four cases and to the pancreas in one.

Only three palliative operations were performed, an ileostomy in Case VII, a gastroenterostomy in Case IX and a cholecystenterostomy in Case X.

Only one radical operation was done, that of Case XI, in which a resection of a portion of the duodenum with transplantation of the common duct into the stomach

and a posterior gastroenterostomy were carried out.

*Treatment.* It is obvious that a large number of these patients were seen only after the disease had reached an inoperable stage. In such cases palliative measures for the relief of biliary or intestinal obstruction will sometimes give some measure of comfort for the remaining weeks or months of life.

The problems that must be solved in a successful resection of a tumor of the duodenum are numerous and difficult. They will vary somewhat with the location. It seems obvious, however, that they are most difficult for tumors in the papillary area. This, of course, is the location of a large percentage of duodenal tumors. The pancreas, pancreatic duct or ducts and the common bile duct must be dealt with. Biliary drainage must be provided for by an anastomosis of either the common bile duct or gall-bladder to the stomach or intestine. Provision must be made for emptying of the stomach in those cases where the intestinal continuity is interrupted.

In the relatively recent literature there have appeared papers by advocates of two types of operation for tumors in the papillary area. One method is that advocated by Hunt and Budd,<sup>4</sup> in which a one stage operation with transduodenal resection of peri-ampullary tumors with reimplantation of the biliary and pancreatic ducts was advised. Whipple,<sup>3</sup> after unsatisfactory experience with one stage operation, has worked out a procedure, the salient points of which are:

1. No attempt at a re-establishment of the continuity of the duodenum following the resection.

2. A two stage operation which includes a posterior gastroenterostomy, section and ligation of the common bile duct and a cholecystgastrostomy in the first stage. The second stage, which is carried out three or four weeks later, includes a ligation of the pancreaticoduodenal and gastroduodenal arteries and a resection of the

involved portion of the duodenum together with a v-shaped excision of a portion of the head of the pancreas. The pancreatic duct or ducts are ligated.

It would seem that the two stage operation has many things in its favor, the most important of which is that it makes possible improvement of the patient's condition by the relief of biliary and intestinal obstruction at the first stage. The radical departure is the deliberate ligation of the pancreatic duct. While it is difficult to consider lightly the alteration of so vital a physiologic process as the secretion of pancreatic juice, Whipple's<sup>3</sup> experience with two patients on whom this operation was done would seem to justify it. He has shown that even with the loss of drainage of pancreatic secretion into the intestinal tract, fat metabolism is diminished by only about 10 to 15 per cent. Even in those instances where the gall-bladder is found unsuitable for anastomosis, the transplantation of the common bile duct would be considerably simplified.

The relationship of ulcer to carcinoma of the duodenum remains uncertain. Arisz<sup>7</sup> has reported two cases of carcinoma which apparently arose on the basis of ulcer. Jefferson<sup>8</sup> reported another case and collected thirty additional ones. Startz<sup>5</sup> has written on the relationship of ulcer and carcinoma and so has Hinton.<sup>9</sup>

While one must readily admit the possible relationship in those instances where an ulcer has been known to exist for a considerable period before the probable occurrence of carcinoma, the fact remains that an extremely small percentage of ulcers becomes carcinomatous. It can be said safely that ulcer is not a great predisposing cause, if there is any causal relationship at all.

Ewing,<sup>10</sup> however, does feel that carcinomas in the first portion of the duodenum are secondary to ulcers and states that in this particular group stenosis and adhesions are common and that metastases are early and widespread.

The cellular structure of duodenal carcinomas is usually a cylindrical cell adenocarcinoma. All of our eleven cases except one showed this type of tumor. One, Case XI, as noted in the case report, showed an unusual type of cellular structure and was diagnosed as medullary carcinoma.

This is the only instance in our eleven cases where the tumor seemed to have arisen in the ampulla. We have included it because it did reveal a definite tumor of the duodenal wall and is a good example of the difficulty so often expressed of determining the exact origin.

## CHART I

## ADDITIONAL REPORTS OF RADICAL OPERATIONS FOR CARCINOMA OF THE DUODENUM

Reported by	Year	Location of Tumor	Operation	Pathology	Result
1. Syme.	1904	Infra-ampullary	Radical resection and end-to-end anastomosis, duodenum and jejunum	Carcinoma	Operative recovery
2. Dewis and Morse (Morse).	1928	Supra-ampullary	1. Gastrojejunostomy 2. Radical resection first part duodenum and pylorus	Scirrhus adenocarcinoma	Living and well fifteen months later
3. Muller and Rade-maker.	1931	Ampulla of Vater	1. Local removal with cautery 1924 2. Cholecystoduodenostomy 1926 3. Gastroenterostomy 1927	Cylindrical cell adenocarcinoma	Died four years and eight months after first operation of recurrence
4. Schofield.	1931	Infra-ampullary	1. Duodenotomy and cholecystoduodenotomy 2. Duodenotomy and implantation of radon	Adenocarcinoma	Died twenty-nine days post-operative duodenal fistula
5. Bookman.	1932	Supra-ampullary	Local excision of tumor and gastrojejunostomy	Adenocarcinoma from pancreatic rests	Operative recovery
6. Eger (Lower).	1933	Infra-ampullary	Radical resection infra-ampullary portion of duodenum	Carcinoma	Died six years later of undetermined cause
7. Davis.	1935	Infra-ampullary	Radical resection and anastomosis second part duodenum to jejunum	Adenocarcinoma	Died seven days post-operative
8. Hoffman-Pack (Pickhardt).	1937	Ampullary	Excision of growth	Adenocarcinoma	Died six hours post-operative
9. Our Case XI (McClure).	1938	Infra-ampullary	Radical resection; choledochgastrostomy; posterior gastroenterostomy	Medullary carcinoma	Living twelve weeks after operation

The other partial exception was Case I which showed, in addition to the adenocarcinoma, squamous cell carcinoma. This patient had a friable tumor which seemed to originate in the ampulla and spread through the papilla onto the surface of the duodenal wall as a flat, granular tumor 2 cm. in diameter.

Outerbridge,<sup>11</sup> in 1913, collected a series of 110 cases which he grouped under the caption of "Carcinoma of the Papilla of Vater." He admitted that some of the tumors may have had their origin elsewhere, but felt that an exact histologic differentiation was impossible and in fact useless.



Ewing<sup>10</sup> states that except in very early cases it is difficult to determine the exact origin, that is, whether it is from the lining of the ducts or the wall of the duodenum at the papilla of Vater. He adds, however, that the jaundice in those cases due to carcinoma of the papilla is "less severe and persistent than with carcinoma of the ampulla." In each instance the structure of the tumor is usually a cylindrical cell adenocarcinoma and the treatment identical. The differentiation as to origin, then, is largely one of academic interest only.

We have reviewed reports of 193 cases. Fifty-nine of these were collected and reported by Cohen and Colp,<sup>12</sup> twenty-two by Whipple<sup>3</sup> and eighteen by Hunt and Budd.<sup>4</sup> This last group includes eleven cases also reported by Whipple. The three groups were made up of a total of eighty-eight cases, on whom some attempt at a radical cure of carcinoma in the periampullary region of the duodenum had been made. To these groups may be added an additional nine cases including our Case XI (Chart 1). While no large portion of this total of ninety-seven cases was benefited for a long period of time, twenty-five were reported as living for a period of from one to twenty-two years following operation.<sup>13</sup> Of the remaining ninety-seven cases, fifty-five had palliative operations and forty-two had either no operation or abdominal exploration only.

The remainder of the case records which we reviewed are listed in the bibliography under numbers 14 to 42.

The pathologic diagnoses in our cases were made by Dr. Frank W. Hartman.

#### CONCLUSIONS

1. The diagnosis of carcinoma of the duodenum is extremely difficult.
2. The symptom complex of our cases was not diagnostic of anything other than a disease of the gastrointestinal tract.
3. The presence of occult blood in the stool, not otherwise accounted for, should make one suspicious of a duodenal tumor. It is probably the most valuable aid in the

differentiation of benign and malignant disease. Disregard of it will lead to mistaken diagnoses.

4. X-ray filling defects in the duodenum are helpful in diagnosis, but are often not seen. The development of a special technique for examination of the duodenum seems essential.

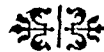
5. The operative treatment of duodenal tumors is an involved and difficult procedure. It is deserving of further development.

I am indebted to Dr. R. D. McClure for his assistance and for the use of his clinical records.

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# THE SURGEON'S PROBLEM IN DUODENAL ULCER

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**D**UODENAL ulcer is not a local disease, but rather a local manifestation of a constitutional disturbance. It is often linked with gastric ulcer, and both are referred to as "peptic ulcer." However, the grouping together of gastric and duodenal ulcer is unwise. To refer to these ulcers as peptic ulcers has led to no end of confusion, and presupposes the erroneous conclusion that we know the cause of such ulcers. We believe that the potentialities of disaster, the morbidity, and the associated economic disturbance accompanying a gastric ulcer are entirely different from these same factors when associated with a duodenal ulcer. For this reason we urge a consideration of these two diseases as separate and distinct clinical entities. To emphasize further the value of this differentiation, all will agree that carcinoma as a complication of duodenal ulcer is for all practical purposes nonexistent, whereas it is the *bête noire* of every patient who suffers from a gastric ulcer.

The cause of duodenal ulcer is unknown. We do, however, know that duodenal ulcer is a disease which occurs in early adult life, during the age of greatest mental and physical responsibility and activity; that it is accompanied by a high incidence of free hydrochloric acid in the stomach contents; that the use of tobacco and alcohol aggravates the symptoms; that fatigue, both mental and physical, is incompatible with freedom from symptoms; that the removal of foci of infection is occasionally accompanied by relief. Indeed, in our Surgical Department, we believe that the surgeon has no interest in nor responsibility to the patient who is suffering from an uncomplicated duodenal ulcer. The regulation of diet and the medical regimen which are advised by the

Medical Department of the University of Toronto are so efficient that there is no need for surgical consultation in the uncomplicated case. Occasionally, however, the surgeon is called in consultation with a view to operation because the patient is so utterly devoid of self-discipline that he has been unable to carry out the medical regimen suggested. The lot of the surgeon who accepts such patients for operation will indeed be unhappy. We are firmly of the opinion that any surgical therapeutic procedure is at best a physiologic makeshift, and must be accompanied by, but never a substitute for, self-discipline on the part of the patient, in addition to a well-regulated medical regimen.

A survey by MacFarlane<sup>7</sup> of a series of patients subjected to surgical operation within two years of their first symptoms, disclosed the appalling fact that there was a failure to relieve symptoms in 46 per cent of cases. This might be interpreted as inadequate surgery, but our present interpretation is that it was unnecessary surgery, carried out as a substitute for the self-discipline of the patient, or in lieu of an adequate and prolonged medical regimen.

We now have come to believe that surgical procedures are only of value in dealing with the complications of duodenal ulcer. We recognize the following complications:

1. Perforation
2. Obstruction—pyloric
3. Penetration
4. Recurring hemorrhage
5. Duodenal ulcer occulta.

*Perforation.* The acute perforation of a duodenal ulcer constitutes an abdominal emergency of the greatest gravity. Failure to recognize and diagnose this lesion soon after its occurrence is followed by dis-

astrous results. Some years ago a survey of our fatalities in patients who had suffered an acute perforation of a duodenal

tance in producing the disastrous clinical state which such patients present many hours following an acute perforation of a

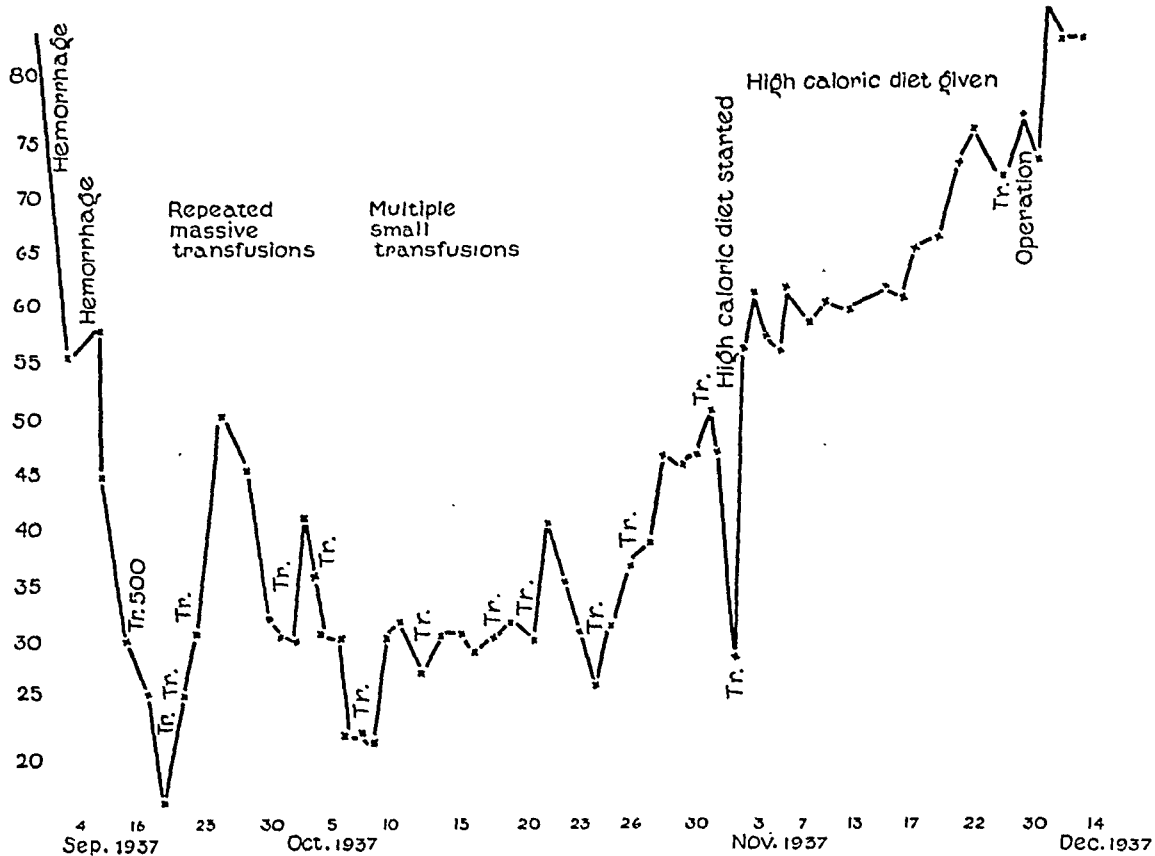


FIG. 1. Graph showing the value of feeding to patients who have suffered violent hemorrhage, a diet with a high caloric value, rich in animal protein. Patient was admitted September 4, 1931, following severe hemorrhage. Between this date and November 2, he had eighteen transfusions of varied volume and interval. On the latter date, a high caloric diet, rich in animal protein, was given, followed by a spectacular rise in hemoglobin permitting radical gastrectomy December 6. (From Graham, in *Surg., Gynec. & Obst.*, 66: 269-287, 1938.)

ulcer led us to adopt, as a fundamental guiding principle in the treatment of these patients, a careful assessment of the factors which are responsible for the fatality, as well as—and what we now believe to be more important—the factors which are responsible for the serious clinical state of such patients on admission to hospital. We had been impressed with the necessity for immediate operation, because of the fear of the development of the widespread peritonitis which has been the almost invariable report on the autopsy examination of fatal cases.

As a result of our deliberations<sup>5</sup> we believe that the biochemical disturbances of the circulating fluids and salts, together with the exhaustion resulting from pain and sleeplessness, are of extreme impor-

duodenal ulcer. With this in view, we undertook, in the late cases in whom previously the mortality was so high, to correct the biochemical disturbance by the administration of sedatives, heat, intravenous fluid and salt, together with nourishment in the form of blood or glucose, before any operation was undertaken. We have delayed as long as eight hours, in order to accomplish this, before undertaking any operation. The results have been surprising. We now have operated upon sixty-two consecutive perforated duodenal ulcers, with but two deaths. One was an elderly man who suffered from a serious cardiorenal lesion and died on the operating table while preparing for operation. No autopsy was permitted, and we believe he died of a cardiovascular acci-

dent. The second case died on the tenth day from a massive pulmonary embolus, and autopsy revealed the peritoneal cavity

We believe that obstruction due to edema is the result of increased inflammation about the ulcer itself. Continuous

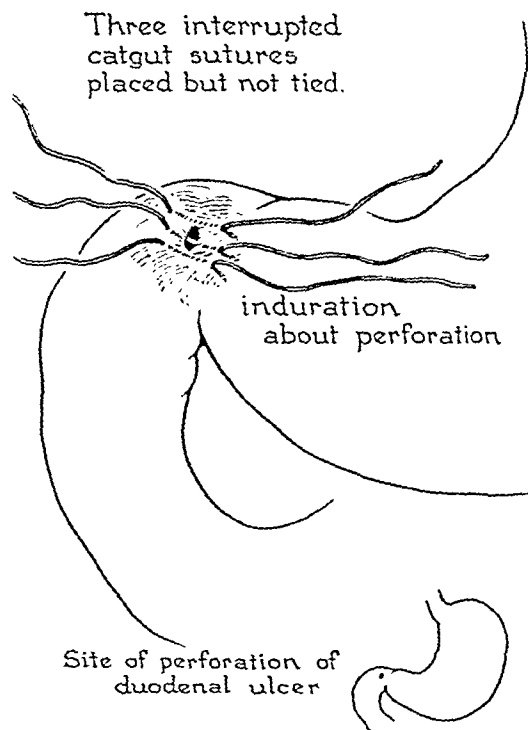


FIG. 2. The placing of sutures in relation to perforation. (From Graham, in *Surg., Gynec. & Obst.*, 64: 235-238, 1937.)

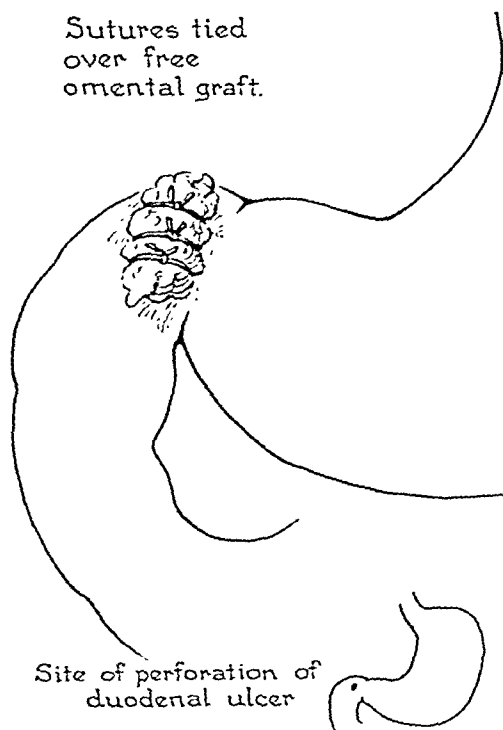


FIG. 3. Sutures tied over free omental graft. No attempt is made to close the perforation by the suture. They are tied only sufficiently tight to hold the graft in situ. (From Graham, in *Surg., Gynec. & Obst.*, 64: 235-238, 1937.)

to be healed. These results are so at variance with our former practice of immediate and precipitate operation, without correcting the biochemical disturbance, that we now feel justified in urging that this be carried out in every case before operation is undertaken.

**Obstruction.** Pyloric obstruction, the result of a duodenal ulcer, presents one definite pitfall. This is the differentiation of the obstruction due to scar from that due to edema. The obstruction which is due to scar has been progressively increasing over a very long period, and has been accompanied in many instances by vomiting at the end of the day. An obstruction which is due to edema, however, is much more sudden in its onset, is usually accompanied and immediately preceded by a marked aggravation of the pain, and is associated with profuse and recent vomiting.

suction through a duodenal tube passed into the stomach will keep the stomach empty. Fluid balance and food requirements are achieved by means of the intravenous administration of glucose in saline or water. At the end of a week or ten days of such treatment, the edema will have so decreased that the obstruction will have disappeared, to a degree at least, and prolongation of this treatment will, in such cases, be followed by the complete disappearance of all evidence of obstruction, both clinical and radiographic.

In addition to this, further investigation of cases of obstruction will show that, associated with the pyloric stenosis due to a scar, there will be a low incidence of free hydrochloric acid in the stomach in most instances, whereas in the case of obstruction due to edema there is associated a

high incidence of free hydrochloric acid. We are firmly convinced that the presence of free hydrochloric acid, as demonstrated

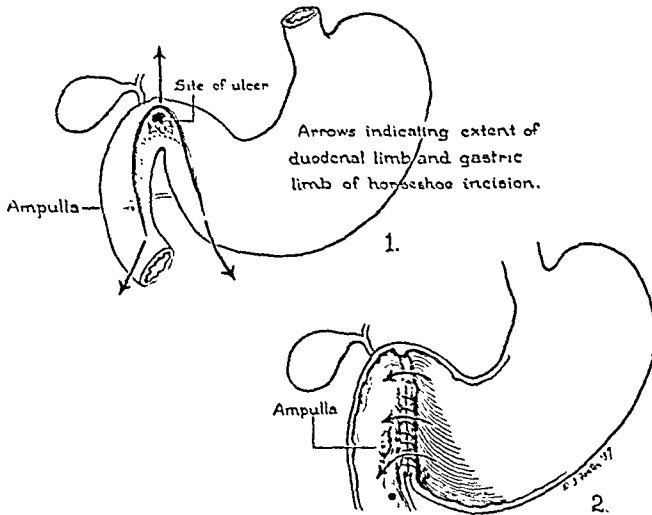


FIG. 4. Details of Finney pyloroplasty in which the stoma is large and extends below the entrance of the common bile duct. (From Graham, in *Surg., Gynec. & Obst.*, 66: 269-287, 1938.)

by gastric analysis, is of such vital importance in determining the proper operative procedure that it should always be estimated before any decision is made. In other words, we believe that the surgical operation which will produce a brilliant result in a patient suffering from a scar stenosis accompanied by a low free hydrochloric acid content on gastric analysis, will be followed by a high percentage of disasters if applied to the patient suffering from edema stenosis accompanied by a high incidence of free hydrochloric acid.

**Penetration.** The patient who is suffering from a penetrating duodenal ulcer has a clinical history of distress, not the usual post-meal distress which is relieved by food and followed by long periods of freedom from disability, so characteristic of the ordinary uncomplicated duodenal ulcer. When there is penetration into the pancreas, liver, or other adjacent structure, the patient really is suffering from a localized peritonitis. The disease process has gone beyond the confines of the duodenum and therefore is more than a duodenal ulcer. This conception, we believe, is very sound and important in the proper evaluation of the various operative procedures.

While the usual syndrome of post-meal distress accompanies a penetrating duodenal ulcer in a fair percentage of cases,

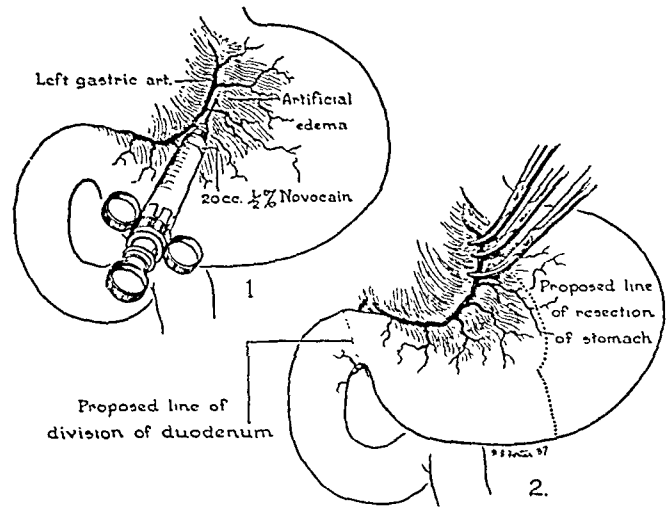


FIG. 5. Production of artificial edema in gastrohepatic omentum high on the lesser curvature, with the method of isolating and triple clamping the left gastric artery. (From Graham, in *Surg., Gynec. & Obst.*, 66: 269-287, 1938.)

food relief is not so constant. There are no major remissions with complete absence of symptoms. Posture has a very definite effect upon the degree of discomfort in that recumbency is often essential to complete relief and the erect posture is immediately followed by a return of the distress. Pain radiating through to the back is present in a high percentage of such cases, and is of great diagnostic value.

The x-ray diagnosis of penetration is uncertain, and in a large percentage of instances impossible, even when undertaken by a most expert radiologist. This emphasizes the need for a careful history and physical examination, when an accurate diagnosis so greatly depends on the analysis of the history and the physical signs. The inability of the ordinary dietetic, medicinal and hygienic regimen to bring to these patients a degree of relief sufficient to enable them to carry on their ordinary economic responsibilities, makes essential the consideration of operative therapy.

**Recurring Hemorrhage.** It seems trite to state that not all hematemesis is the result

of an ulcer in the stomach or duodenum. The clinician's primary responsibility to a patient suffering from hematemesis is to

We have not had sufficiently extensive experience to make any statement in regard to the wisdom of immediate operation

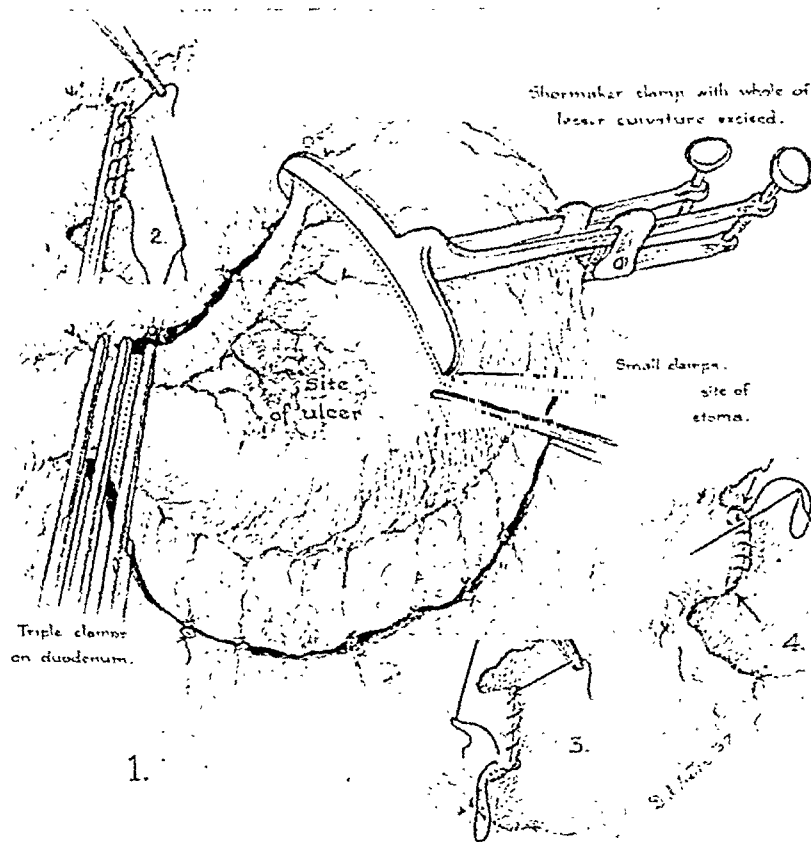


FIG. 6. The application of the three forceps before the division of the duodenum, and the method of closing the duodenum. The application of the Schoemaker clamp is also shown and the method of outlining the stoma near the greater curvature. (From Graham, in *Surg., Gynec. & Obst.*, 66: 269-287, 1938.)

exclude lesions other than ulcer which might be the cause.

Granted that the diagnosis of a duodenal ulcer accompanied by massive hemorrhage has been substantiated, what is our responsibility? We do not believe that in the young patient a single massive hematemesis is sufficient justification for operation. The recent survey of Dr. Allen<sup>1</sup> of the Massachusetts General Hospital in Boston, together with the experience of Mr. Gordon Taylor<sup>4</sup> of the Middlesex Hospital, has impressed upon all who are interested in this problem that there is a very definite difference in the seriousness of massive hematemesis in patients under, as opposed to those over, fifty years of age.

for hematemesis upon patients who are candidates for such therapy. A recent experience, however, has confirmed the statement which Mr. Gordon Taylor has emphasized on more than one occasion, namely: "If one is going to carry out an emergency surgical procedure for massive hematemesis, it had better be done within the first forty-eight hours, or a fatality will result, even though by means of the continuous transfusion, as advised by Marriott,<sup>8</sup> the hemoglobin has been brought up to 80 per cent."

In our recent experience, we had a patient admitted one week after a massive hemorrhage from a duodenal ulcer, in which the hemoglobin was down to 30 per cent. By means of continuous transfusion,

his hemoglobin was restored to 60 per cent, at the end of which time he had a further massive hemorrhage, and the hemoglobin

hemorrhage of sufficient volume to lower the hemoglobin below 50 per cent, operation should be seriously debated before

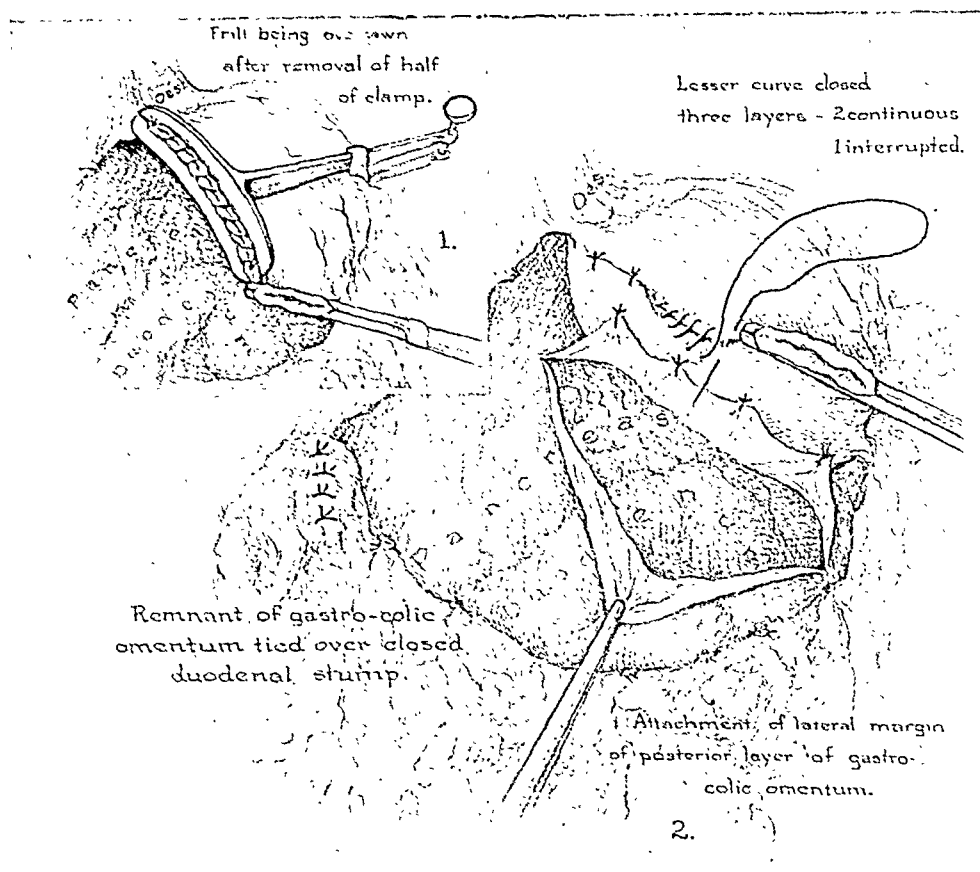


FIG. 7. Method of closing the newly formed lesser curvature. The frill remaining after removal of half the clamp is oversewn and buried with a second layer of continuous catgut and reinforced with interrupted silk. Preparation for a posterior Polya reconstruction by uniting the lateral cut margin of the posterior layer of the lesser sac by interrupted sutures to the posterior wall of the gastric remnant. The method of suturing the remnant of the gastrocolic omentum over the duodenal stump to make a more secure closure is also shown. (From Graham, in *Surg., Gynec. & Obst.*, 66: 269-287, 1938.)

fell again to 45 per cent. Further transfusion and operation were followed by a fatality. This is a typical sequence of events, which Gordon-Taylor has warned us against, and our only justification for considering operation on such a patient was our firm conviction that we had no choice but to lose our patient without an effort, or to run the remote chance that such a procedure might save his life.

We should like to counsel, however, that in the young individual, a single massive hemorrhage is not sufficient indication to warrant either an immediate or a subsequent operation, but in the older individual (over fifty) where there has been a

dismissing this patient to a purely dietetic regimen. We believe that the source of such massive duodenal hemorrhage is from a duodenal ulcer situated on the posterior wall and communicating with the pancreaticoduodenal artery or one of its branches. As a result of this belief, we must question the wisdom of any surgical procedure which is not accompanied by ligation of this blood supply. As a corollary, such a procedure must be accompanied by a resection of the pyloric end of the stomach. While we have carried out indirect types of operative procedures on a small group of patients and the patients have recovered, this has been done only



because we were fearful of a more formidable procedure, and it is in this decision that the judgment and experience of the

After two months Lewis<sup>12</sup> suggested that the patient could be made no worse and at least his hunger could be assuaged by a

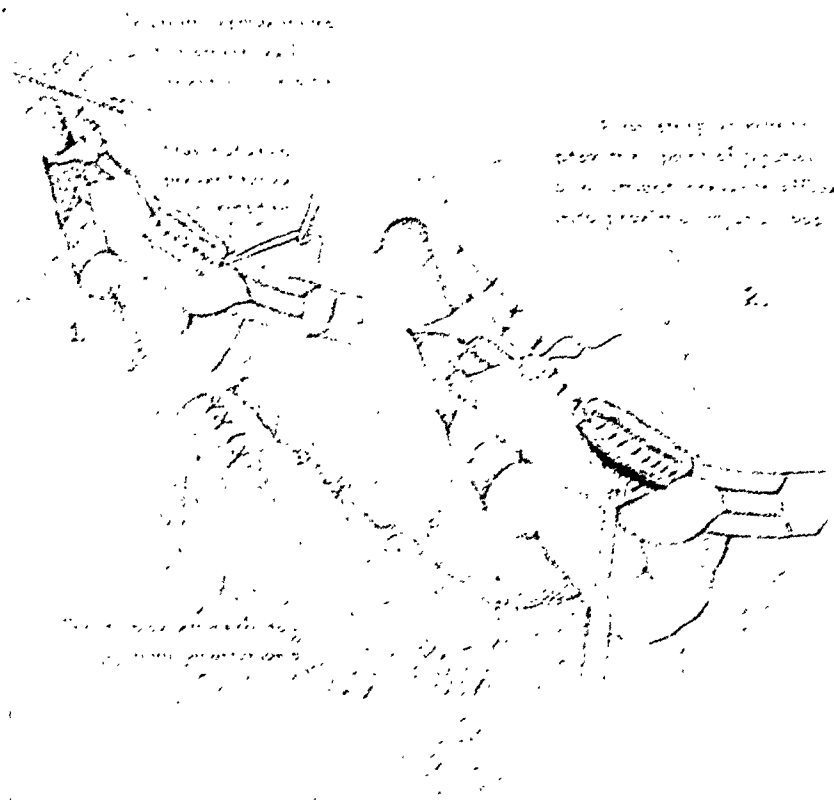


FIG. 2. The use of the two stay sutures to prevent axial rotation of jejunum; also the insertion of purse-string sutures to hitch the proximal jejunum well up on the lesser curvature, thus preventing gastric contents from emptying into the proximal jejunal loop. Clamps are shown at the anastomosis for clarity, but we prefer to dispense with clamps, as they are too traumatic. (From Graham, in *Surg., Gynec. & Obst.*, 66: 269-287, 1933.)

surgeon account for so much. As a fundamental principle, we feel that whenever operation is indicated, if it is deemed wise and possible, the radical and direct attack upon the source of the bleeding should be carried out.

Prior to 1931 all patients who were being prepared for operation following a massive hemorrhage were fed very cautiously and in small amounts, a bland diet of milk and foods made from milk. In September 1931 a patient was admitted after a massive hemorrhage, but the usual dietetic control was accompanied by further hemorrhage. Transfusions were used, in volume from 250 c.c. to 1000 c.c. at intervals of a week to every other day.

more liberal diet, and if we were generous in adding an abundance of animal protein, the resulting stimulus to hemoglobin formation might be beneficial. This was carried out, and the spectacular rise in the hemoglobin and the improvement in the patient's condition were delightful. (Fig. 1.)

Since this experience we have rapidly increased the diet of patients recovering from massive hemorrhage from duodenal ulcers. Now by the fifth to the sixth day after the violent bleeding has ceased, these patients are on a generous and varied diet containing an abundance of meat, eggs, fish and fowl, the only safeguard being that the vegetables are puréed and the meats are minced. In addition the ad-

ministration of reduced iron we believe to be very beneficial.

*Duodenal Ulcer Occulta.* This duodenal

of the bizarre nature of the indigestion and the accompanying jaundice, and it was not until the abdomen was opened that

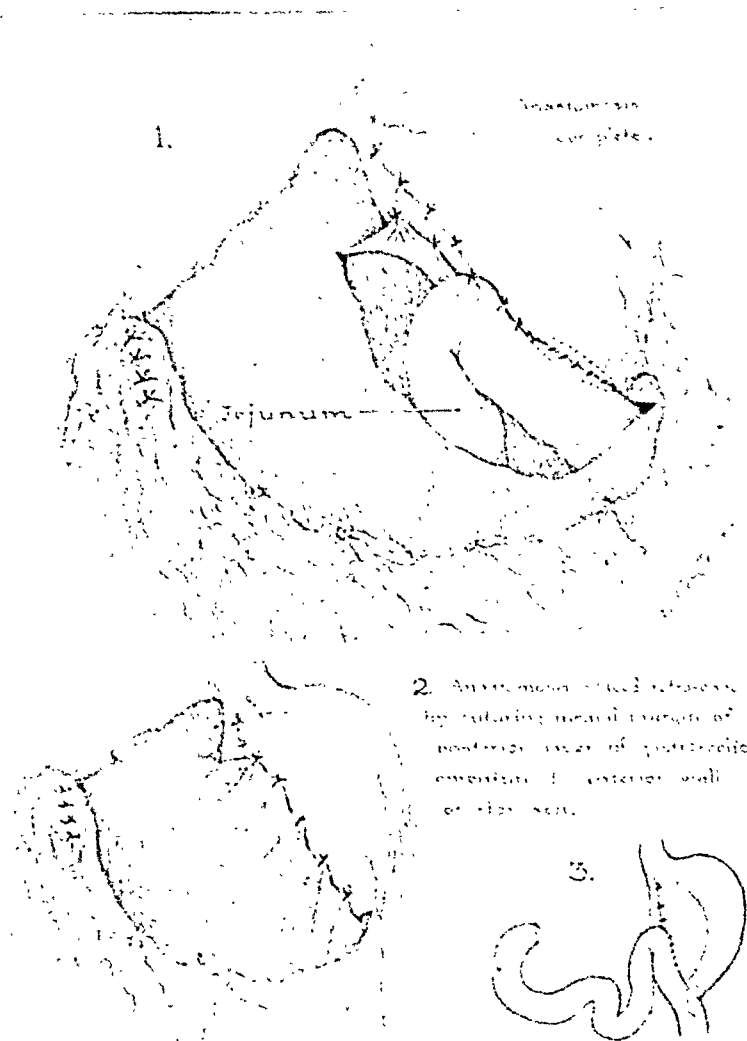


FIG. 6. The completion of the retrocolic anastomosis, the medial layer of gastrocolic omentum being sutured to the anterior wall of the stomach. The duodenal stump is covered with fat and the diagram (inset 3) shows the proximal jejunal loop well sutured on the newly formed lesser curvature, showing how the discharge of gastric contents must go into the distal jejunal loop. (From Graham, in *Surg., Gynec. & Obst.*, 66: 269-287, 1938.)

ulcer we have encountered unexpectedly, hence the designation "occulta." The symptom complex has defied a clinical diagnosis of duodenal ulcer, and the radiologic investigation of the gastrointestinal tract has failed to reveal the presence of a duodenal ulcer. Yet the degree of abdominal pain, invalidism and economic inefficiency which these patients present has led to a laparotomy. In some of the cases the operation was undertaken with a diagnosis of biliary disease because

the real lesion was diagnosed. This invariably has been a large duodenal ulcer, situated on the posterior wall of the second portion of the duodenum. In the cases in which jaundice was present, this symptom was the result of edema which had spread to and produced a partial obstruction of the common bile duct.

In the first case in which we found this lesion the patient had been operated upon twice before, once for an appendectomy and the second time for removal of the

gall-bladder, without the diagnosis being made. He then fell into our hands. With obliteration of the peritoneal cavity on the

cases have carried out a partial gastrectomy as a primary procedure.

Surgical procedures thus become neces-

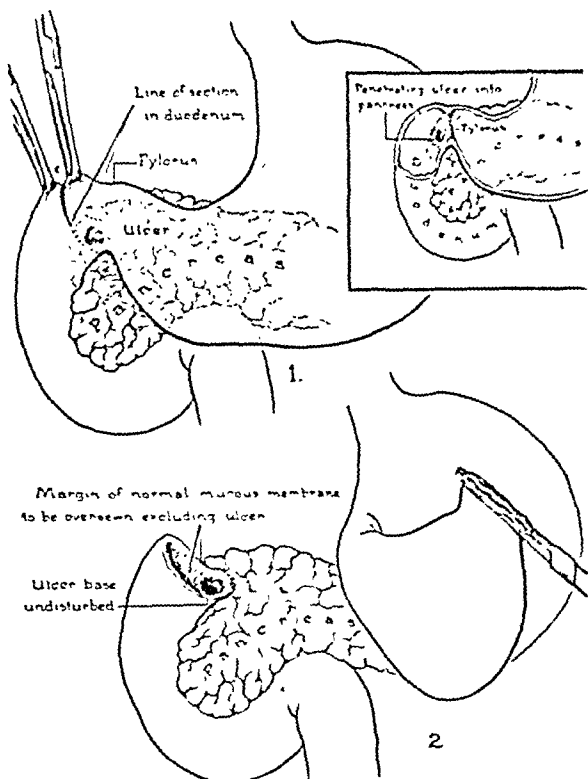


FIG. 10. Scheme of dividing duodenum and separating the pyloric end of the stomach in the presence of a penetrating posterior duodenal ulcer, preparatory to exteriorizing the ulcer. (From Graham, in *Surg., Gynec. & Obst.*, 66: 269-287, 1938.)

right side due to previous operations, when the dissection was finished, one found a mass the size of a golf ball occupying the posterior wall of the descending limb of the duodenum, with a crater which would admit the tip of the thumb. The dissection was so difficult because of the dense adhesions, that the blood supply of the right colon was interfered with, making resection necessary, and no operation was directed towards the ulcer. Three weeks later a posterior gastroenterostomy was done. This man returned to us on several occasions with a recurrence of his pain and jaundice, and finally, after four years, had to submit to a partial gastrectomy. Since operation four years ago he has been perfectly well.

We now have encountered this lesion seventeen times, and in all the subsequent

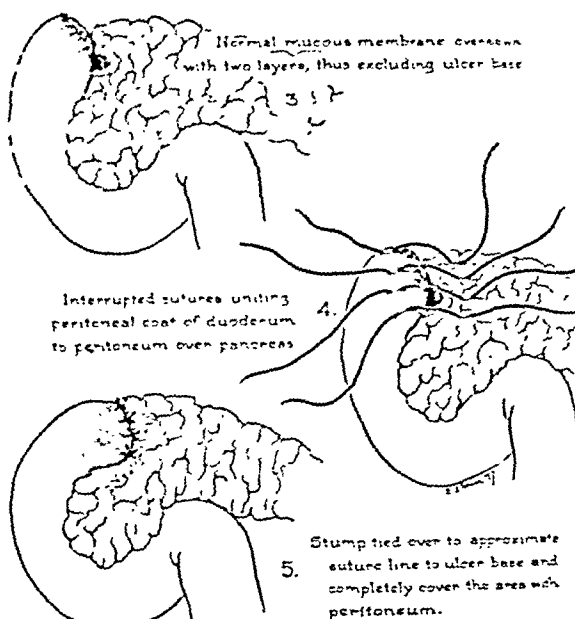


FIG. 11. Method of closing duodenal stump and exteriorizing the base of penetrating posterior wall duodenal ulcer which has been left undisturbed in situ. (From Graham, in *Surg., Gynec. & Obst.*, 66: 269-287, 1938.)

sary for acute perforation, pyloric obstruction due to scar, penetration with involvement of contiguous structures, recurring massive haemorrhage, and for duodenal ulcer occulta.

**Surgical Procedures in Acute Perforation of Duodenal Ulcer.** The surgical procedure for acute perforation of a duodenal ulcer which we now carry out exemplifies, we believe, one of the sound principles in all emergency abdominal surgery: "Carry out only the most simple surgical procedure which will adequately control the lesion which has created the emergency." This means that, after correction of the biochemical upset, closure of the perforation is all that is necessary to save the patient's life. Even though there be a high degree of pyloric obstruction due to edema about the perforated ulcer, there should be no change in the surgical application of this fundamental principle, because by means of suction on a duodenal tube in-

dwelling in the stomach, together with the intravenous administration of fluid, glucose, saline and blood, the patient can be tided over the acute emergency. In other words, we believe that we have, in this condition, no responsibility as surgeons to carry out any procedure designed to cure the original duodenal ulcer, but must confine our efforts solely to saving the patient's life at the moment of the emergency.

Efficient closure of the perforation is only possible through the formation of fibrin. This can be stimulated by the trauma of even the most gentle operative interference, together with the contact of traumatized cells. We have in this group of cases closed the perforation by simply using three interrupted catgut sutures tied over an omental graft, free or attached. This permits the rapid and massive formation of fibrin and effectively closes the ulcer. The operative trauma is reduced to a minimum; the duration of the operation is but a few minutes. Sixty-two consecutive perforations with but two deaths, one from embolus and one from a cardiovascular accident on the table, have settled for us definitely any remnant of doubt as to the inadvisability of combining closure of the ulcer with a gastroenterostomy or other surgical procedure directed to the cure of the ulcer. (Figs. 2 and 3.)

*Surgical Procedure for Chronic Duodenal Ulcer.* Any surgical procedure carried out for chronic duodenal ulcer should be accompanied by a low mortality, a restoration of the economic efficiency of the individual, freedom from symptoms, and security against recurrence of the ulceration. At the present time we have no surgical procedure which invariably will fulfill all these requirements. In the cases in which the surgical operation has failed to achieve this ideal result, there has been, in our experience, a failure in each instance to abolish or bring to a low level the free hydrochloric acid in the gastric contents. In addition the lack of self-discipline or the failure to have advised and planned an

efficient post-operative regimen, has been noted.

Thus as a fundamental in determining

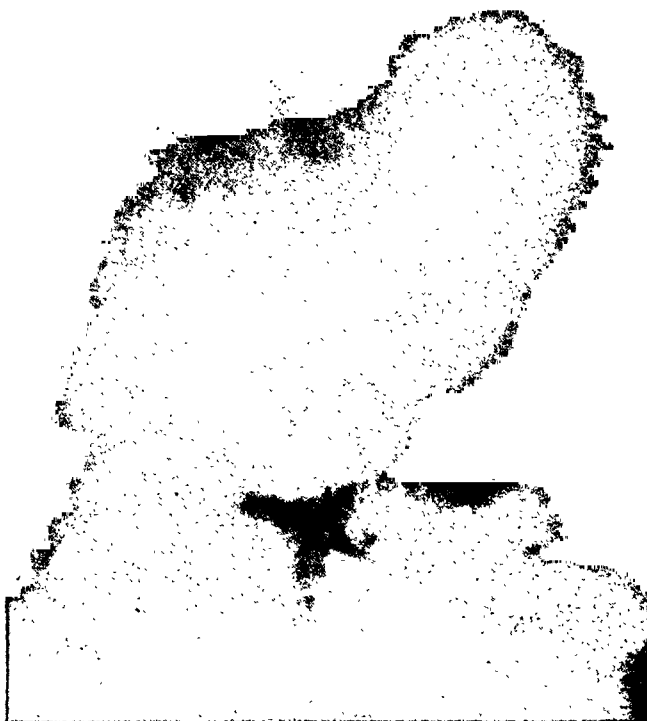


FIG. 12. X-ray study of a short loop posterior gastroenterostomy taken in the erect position, showing the stomach held up on the shelf of the gastrocolic omentum. Subsequent studies show the stoma to lie higher than the pyloric antrum, with resulting imperfect drainage of the stomach and ultimate development of a jejunal ulcer. (From Graham, in *Surg., Gynec. & Obst.*, 66: 269-287, 1938.)

the correct operative procedure, we must be certain that our patient suffers from a complication of duodenal ulcer, i.e., obstruction, penetration or recurring haemorrhage; that an adequate dietetic, hygienic and medicinal regimen has failed to control the symptoms; that tobacco and alcohol have been dispensed with; that the patient has attained sufficient self-discipline to enable him to carry out an adequate post-operative regimen, and that all sources of focal infection have been efficiently investigated and effectively dealt with. The operative procedure should decrease to low levels or abolish entirely the presence of free hydrochloric acid in

the gastric contents. It should result in adequate emptying of the stomach, and freedom from gastro-intestinal spasm.

The surgical procedures available to us may be grouped in two large classes: first, the indirect approach, as exemplified by gastroenterostomy, the various pyloroplasties, gastroduodenostomy and gastric transection; and second, the direct attack, in which the ulcer itself is excluded from the gastrointestinal tract and an adequate gastric resection is done, such resection including the excision of the pyloric antrum. The removal of the pyloric antrum is carried out because of our belief that by leaving it in situ there is produced a hormone which stimulates acid production in the fundus.

As a result of the follow-up studies which we have made on a group of patients during the last eight and one-half years, certain findings have impressed themselves on us. First, the older the patient suffering from duodenal ulcer, the less likelihood is there of high free hydrochloric acid, and extreme gastric hypermotility is not an outstanding accompaniment. As a corollary to this statement, the young individual suffering from duodenal ulcer has marked gastric hypermotility and a very high incidence of free hydrochloric acid on gastric analysis. In the presence of scar stenosis, there is an atrophy of the secreting glands of the stomach, resulting in a low incidence of free hydrochloric acid in the stomach. If pyloric stenosis be due to edema, hypermotility of the stomach with a high incidence of free hydrochloric acid is an accompaniment.

The clinical results in patients we have studied in our follow-up clinic, have led us to abandon all operations employing the indirect approach, with the exception of a posterior gastroenterostomy and a Finney pyloroplasty. All the other procedures as carried out by us have led to such a high percentage of unhappy end results, that we have ceased to utilize them in the surgical treatment of duodenal ulcer. We reserve a gastroenterostomy

solely for the patient with the definitely proved pyloric stenosis due to scar, accompanied by a low free hydrochloric acid content of the stomach. In this case we really are operating for a gastrointestinal obstruction, the result of a healed duodenal ulcer. These patients are usually in the latter half of their life cycle, and the results of operation are excellent.

A Finney<sup>3</sup> pyloroplasty, we believe, has a definite place in the treatment of the elderly patient with a penetrating duodenal ulcer associated with a low free hydrochloric acid in the stomach contents. Indeed, we have on several occasions used this operation when there was a large penetrating posterior wall ulcer. The ulcer itself was left undisturbed, as any attempt at its excision was not compatible with a Finney pyloroplasty. To our delight, these patients have had happy and satisfactory end results.

This leaves the final group of individuals with penetrating duodenal ulcers with a high incidence of free hydrochloric acid in the stomach and a complete absence of pyloric obstruction. Such a clinical syndrome, particularly if it occurs in a young individual, presents what to us has been the most difficult clinical problem associated with the surgical therapy of duodenal ulcer. We have now come to believe that the only satisfactory surgical procedure for this group of patients is a subtotal gastrectomy, which includes excision of the pyloric antrum. Ogilvie<sup>9</sup> has written in the past of the physiologic approach in which the pyloric antrum is left in situ because of its value in preventing the development of anemia following extensive gastric resection. His recent experience of recurrent ulceration with this procedure has led him now to question its wisdom. Professor Best<sup>2</sup> of our Department of Physiology, assures me that the anti-anemic factors present in the pylorus are also present in the duodenum, and are sufficiently active to prevent the development of anemia from this source. We have not as yet encountered a single case of

pernicious anemia which has followed upon a radical gastric resection, nor have we encountered in our follow-up a single case of severe post-operative anemia which could not be explained either by an insufficient caloric intake or by a diet that was badly balanced. All have responded to an adjustment of the diet and the administration of iron. Therefore we believe that the *bête noire* of severe anemia following a radical subtotal gastrectomy is not founded on a sound hypothesis. In addition the opponents of radical gastrectomy for duodenal ulcer have made the statement that such an operation is incompatible with the demands made upon an unskilled laborer. Our follow-up studies have led us to believe that a man may carry on efficiently and in perfect comfort with the diet, responsibilities and environment common to the unskilled laborer after having submitted to a radical subtotal gastrectomy for duodenal ulcer.

During this period of eight and a half years, we have gradually extended the degree of our resection until at the moment we are doing a radical subtotal gastrectomy, including excision of the lesser curvature and the pyloric antrum, upon all patients suffering from duodenal ulcer in whom we believe a gastric resection is the proper surgical procedure. This radical procedure has come to be accepted because we have found that following the more conservative operations, particularly transection, or in the limited resections, there has not been a constant decrease in free hydrochloric acid, and there has been an incidence of recurrence which we felt should have been avoided. Up to date we have failed to prove a recurrence in a patient upon whom we did the primary operation of radical subtotal gastric resection. We are not suffering from the delusion that such may not yet develop; we know that ulceration may recur many years after gastric operations. However, we do know that at the present time this operation has given more uniformly good results than any other procedure we have

used for the patient suffering from a penetrating ulcer, high free hydrochloric acid in the gastric contents, and an absence of pyloric stenosis.

In the operation undertaken because of recurring hemorrhage, as has been mentioned above, radical gastric resection with ligation of the duodenal blood supply is the procedure of choice.

TABLE I  
RESULTS OF SURGICAL INTERFERENCE IN CHRONIC  
DUODENAL ULCER

	No. of Cases	Deaths	Per Cent Mor- tality
Total operations for duodenal ulcer.....	258	8	3.26
Partial gastrectomy.....	140	5	3.8
Less five dead following radical operation in erroneous diagnosis of cancer.....	135	2	1.4
Gastroenterostomy.....	89	3	3.4
Finney pyloroplasty.....	18	0	0.0
Other operations.....	11	0	0.0

A critical analysis of Tables I and II convinces one that, with careful preparation and meticulous technical procedures, the primary mortality from gastric resections is not of itself sufficiently forbidding to constitute an argument against its use. In this series the gross mortality of 3.8 per cent is rather higher than one would wish; three of the five deaths were contributed to by the erroneous diagnosis of cancer, and consequently a more radical operative procedure was done than we would carry out for duodenal ulcer. The mortality of 1.46 per cent represents our real mortality in gastric resection for duodenal ulcer. There is one subsequent death from a gastrojejunal fistula, where a limited resection was the primary operation. The cases suffering recurrence were submitted to a limited gastric resection. This has determined our present more radical operative procedure.

The end results of the eighty-nine cases upon whom we did a gastroenterostomy

(Table III) is a sad commentary on our use of this operation. Many of the patients upon whom we carried out this procedure had no pyloric stenosis and did have a high incidence of free hydrochloric acid in the gastric contents. We believe the disappointing end results in this group may be explained by the improper selection of patients for this operation.

The three deaths in this group were due to malfunctioning of the stoma. We believe that such malfunction is due in many cases to the axial rotation of the

distal limb of the jejunum, which can unwittingly occur during any gastrojejunal anastomosis, unless definite steps are taken to guard against its occurrence. The edema which accompanies such a rotation is the final factor which produces the disaster. We now believe that prolonged suction drainage of the stomach, combined with a maintained fluid balance by the intravenous administration of fluids, salts and glucose, will save many such patients who suffer from edema at the gastrojejunal anastomosis.

TABLE II  
RESULTS OF GASTRIC RESECTION FOR DUODENAL ULCER  
140 CASES—5 DEATHS—3.8%  
ANALYSIS OF DEATHS

Clinical Problem	No. of Cases	Cause of Death
Erroneous diagnosis of cancer and unnecessarily radical operation.	3	Peritonitis. Pneumonia. Duodenal fistula.
Emergency resection for persistent massive hemorrhage.	1	Admitted one week after hemorrhage began. Carried with massive transfusion; further hemorrhage occurred; radical gastrectomy done, followed by death from hemorrhage, the source of which could not be determined at autopsy.
Penetrating duodenal ulcer—high acid, no pyloric stenosis.	1	Cardiovascular accident tenth day. No autopsy permitted.

ANALYSIS OF RECURRENCES

Type of Operation	No. of Cases	Subsequent History
Billroth I—limited resection (in one case ulcer base left in situ).	2	1. Recurrence duodenal side of the anastomosis—ultimately died of hemorrhage. 2. Recurrence on gastric side of the anastomosis—ultimately died of hemorrhage.
Posterior Polya—limited resection.	2	1. Gastrojejunocolic fistula: Operation. Died. 2. Jejunal ulcer: Reoperation: Recurrent jejunal ulcer: well at present on medical regimen.
Limited resection—anastomosis stomach to descending duodenum.	1	Recurrent ulceration at stoma: Reoperation: jejunal ulcer: recurrent hemorrhage: well at present.
Primary radical resection.	1	Jejunal ulcer suspected clinically and radiographically, January 1937. No radiographic evidence of ulcer in Sept. 1937. Patient suffering no digestive disturbance.

The high incidence of jejunal ulceration is not necessarily a condemnation of the operation, but is definitely the result of erroneous judgment in selecting the patients for whom this procedure is applicable.

TABLE III  
GASTROENTEROSTOMY FOR DUODENAL ULCER

	No.	Deaths	Per Cent Mortality
Total cases.....	89	3	3.3
Anastomotic ulcers.....	11		
Proven by operation.....	7		
Clinical and radiographic diagnosis.....	4		

*Details of Technical Procedure.* It is unnecessary to reiterate all the details of the operative procedures for duodenal ulcer. They are well known, and can be found in many text books. There are, however, certain points which we have come to rely upon as helpful in carrying out operations for duodenal ulcer.

*Finney Pyloroplasty.* We have recently revived our interest in this surgical procedure, and the happy results which have attended its use in properly selected cases are due in no small measure to the fact that we probably have become more proficient in the technique of the operation. Two points have made for this proficiency. *First*, the thorough mobilization of the duodenum, should be done as a definite and deliberate preliminary step by incising the peritoneal reflexion along the lateral wall of the descending limb of the duodenum. In this way the duodenum may be adequately mobilized, and permit of the anastomosis being made without any tension on the suture line, and without any axial rotation of the duodenum. *Secondly*, we believe that an ample stoma should be made. This necessitates carrying the limb of the stoma which is on the duodenum to a point below the level at

which the common bile duct enters the duodenum through the ampulla. This permits of a ready and free interchange of duodenal and gastric contents, and thus counteracts any free hydrochloric acid which may be present in the stomach. (Fig. 4.)

*Gastroenterostomy.* All textbooks and many surgeons lay great emphasis upon the necessity for a short proximal jejunal loop in a posterior gastroenterostomy. In a patient who has visceroptosis, the excursion of the stomach between the prone and the erect posture is so great that with a short loop of jejunum proximal to the stoma, the stomach in the erect posture will be hitched up and the pyloric end will lie on a level below the stoma and thus interfere with adequate emptying. (Fig. 12.) For this reason we use a long proximal jejunal loop whenever we do a gastroenterostomy. We have found no disadvantage to this; in fact it overcomes the difficulty mentioned above, and should the patient be so unfortunate as to develop a jejunal ulcer, it makes the surgical procedure for the cure of this disease safer than if a short loop were present.

*Gastric Resection.* The free mobilization of the duodenum, and the isolation of the blood supply of the duodenum and the stomach, we believe to be of major importance. The left gastric artery can readily be isolated from the lesser curvature by the production of an artificial edema produced by the injection of 20 c.c. of  $\frac{1}{2}$  per cent novocaine along the lesser curvature. The vessel is then triple clamped and divided so as to leave two clamps on the proximal end and one on the distal end. (Fig. 5.) This permits of a double ligature on the proximal end under direct vision, thus ensuring against subsequent hemorrhage. The duodenal stump may be dealt with, as suggested by Shenstone,<sup>10</sup> by means of the application of three Kocher hemostats and dividing the tissues so as to leave two forceps on the duodenal stump and one on the pyloric antrum. The duodenal stump then can be closed ade-



quately by oversewing the frill which will be left by the removal of the proximal hemostat. This row of sutures then can be buried by a second row. The angles of the wound can best be closed if the first stitch of the second layer starts with the needle being inserted parallel to the long axis of the duodenum, as illustrated in Figure 6, and the superior angle can be effectively closed by means of a purse-string. The remnant of the gastroduodenal omentum can be fastened over this closure by means of interrupted sutures.

Such a technique has been effective in preventing duodenal fistulae in all save one instance. The lesser curvature can be amputated and closed with safety by using a Schoemaker<sup>12</sup> clamp. This clamp, which consists of two separate blades, again utilizes the principle of oversewing a controlled frill of tissue. The details of the application of a Schoemaker clamp and the smaller forceps applied near the greater curvature to form the new stoma are well illustrated in Figure 6.

*Posterior Polya Operation.* In restoring the continuity of the tract by means of a posterior Polya operation, the lateral margin of the opening in the gastroduodenal omentum is sutured to the posterior gastric wall before the anastomosis is undertaken. (Fig. 7.) We have felt that one of the most important causes of post-operative vomiting is the axial rotation of the jejunum produced during the course of the anastomosis. In order not to carry the suture line sufficiently far afield to make this possible, all anastomoses are started by placing interrupted sutures at either end of the proposed stoma. Tightening these sutures and putting tension on the proposed suture line until the suture is completed (Fig. 8), prevents such axial rotation. On the completion of the ordinary anastomosis, the proximal limb of the jejunum is sutured by two purse-string sutures to the newly-reconstructed lesser curvature. (Fig. 8.) This serves two purposes: (1) it reinforces the angle of the gastrojejunal anastomosis; and (2) it lifts the proximal

jejunal loop at a level higher than the stoma and prevents the gastric efflux from entering the blind jejunal and duodenal loop. In this anastomosis, as in gastroenterostomy, we believe it is an advantage to use a long jejunal loop. Suture of the medial cut layer of the gastroduodenal omentum to the anterior wall of the stomach then places the anastomosis definitely retrocolic. (Fig. 9.)

In the extensive resections, particularly in the high-lying gastric ulcers, we are now using this technique of gastrojejunal anastomosis in an anticollic position, and, contrary to former experience, have found that the anticollic anastomosis works perfectly well. The only alteration in the technique has been the insertion of the two purse-string sutures which hold the proximal jejunum high on the newly-constructed lesser curvature. In some cases, in which there has been a posterior wall duodenal ulcer penetrating into the duodenum, our belief in the necessity for resection of the pyloric antrum has created a difficult technical problem. We have evolved a technique which will exteriorize such an ulcer without disturbing the base. This technical procedure is adequately presented by means of the illustrations. (Figs. 10 and 11.)

It seems trite to say that the pre- and post-operative care of patients who submit to gastric operations is of the utmost importance. The basic principles which we believe must never be disregarded, but always fulfilled before any operation is undertaken are:

1. The correction of the biochemical disturbances associated with the disease. Outstanding are dehydration, under-nourishment, and secondary anemia.
2. The physiologic upsets accompanying obstruction at the pylorus must be corrected by means of prolonged suction drainage.
3. We believe that spinal anesthesia, using nupercaine, administered and supervised by a competent medical anesthetist, is the ideal anesthetic for such operations.

4. Post-operatively, adequate fluid balance must be maintained. . . . Rest, and freedom from pain must be secured by the judicious use of sedatives.

5. Finally the patients must continue throughout their lives to be moderate in the expenditure of energy, both mental and physical, must continuously abstain from the use of alcohol and tobacco, and follow a regimen of frequent meals, adequate holidays, and controlled responsibility. The realization that no surgical procedure as yet devised is more than a physiologic make-shift, which is no substitute for the self-discipline of a carefully-controlled life is of the utmost importance. The reward of economic efficiency, freedom from physical distress, and the mental peace which accompanies the tranquillity of such a regimen more than compensates for any restriction which may be imposed upon such individuals.

#### CONCLUSIONS

1. Duodenal ulcer is not a local disease: rather is it a local manifestation of a constitutional disturbance.

2. The surgeon is not concerned with the treatment of uncomplicated duodenal ulcer.

3. Surgical procedures are necessary to deal with the complications of duodenal ulcer: perforation, scar stenosis of the pylorus, penetration, recurrent hemorrhage, or in duodenal ulcer occulta.

4. Suitable closure of the acute perforation of a duodenal ulcer after correcting

the biochemical upsets is the surgeon's sole responsibility.

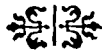
5. No operation should be undertaken for duodenal ulcer until it is proved that the patient has followed an adequate non-operative regimen without relief of symptoms.

6. Indirect operations of gastroenterostomy or Finney pyloroplasty are applicable only to scar stenosis of the pylorus or to a penetrating ulcer, if both are accompanied by a low incidence of free hydrochloric acid in the stomach.

7. In the group of penetrating ulcers with no pyloric obstruction, accompanied by a high incidence of free hydrochloric acid, a radical subtotal gastric resection, accompanied by the excision of the pyloric antrum, is the operation of choice. Such an operation is compatible with comfort and efficiency with the work, diet and environment of an unskilled laborer.

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# GASTRODUODENOSTOMY OR GASTROJEJUNOSTOMY

## CERTAIN ANATOMIC AND PHYSIOLOGIC CONSIDERATIONS

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SO much has been written on the relative merits of the various types of operations on the stomach that any addition to this literature would seem superfluous. Such is possibly the case, but we propose to consider the question from a slightly different approach from that which is commonly employed.

It is quite usual to have any theories, recommendations or conclusions backed up by a more or less imposing array of statistics, the size of whose figures reflects the popularity or prominence of the clinic or individual involved in the report. There are certain fallacies, some apparent, others rather intangible, in such method of argument.

In the first place, the criteria for judging the degree of success or failure of a given procedure may vary widely with different individual investigators and yet be expressed in such terms as to make them appear comparable. Obviously any comparison of such figures under such a misapprehension would be not only valueless, but actually often false and misleading.

In the second place, adequate follow-ups on stomach cases must cover a period of a good many years to be worth anything, and further, should be conducted and judged by some one individual so that the resulting examinations and information may be uniform in basic facts and inferences. Follow-up reports sent in by patients, their families, or other physicians are all too apt to be worthless because of the omission of some important details, or the misinterpretation of signs, symptoms, or statements relating to personal history. Anyone who has attempted any sort of an extensive follow-up will immediately recognize the difficulties referred to. To have the collected data be of real value, every case

should be examined personally by the same individual and according to some uniform plan. Obviously in a large number of instances this would be impossible, since the patients comprising the series are drawn from widely separated communities all over the country. A less obvious corollary which might vitiate figures obtained in any incomplete coverage of a group of cases, is that frequently those whom it is impossible to contact and obtain data on are those who have experienced unsatisfactory results from their operative treatment. Many have meantime gone elsewhere to obtain relief because of loss of faith in the original operator due to such failure.

In the third place, end results of the same operation performed by two different operators may vary widely according to the operative skill of the man employing it rather than any inherent virtue or fault in the operation itself. The same is true from a different angle, namely the patient. One may abuse and ruin a perfectly good operation, while another by care and self-nursing may get along well with an inferior technical job. Such factors are almost impossible to express in group figures, and hence mitigate against their accuracy.

In the fourth place, what might be termed "human frailty" must at times be discounted. Where a person is intensely interested in one particular method or procedure, he may entirely unconsciously and in spite of himself, allow his judgment, and resultant figures, to reflect this prejudice. Or, if he be overly impressed by this danger and determined not to succumb to it, he may go to the opposite extreme, and lean so far over backward in his estimates, as to do an injustice to his pet. In either event, the result would be inaccurate for scientific comparison on a non-partisan

factual basis. For these, as well as other less expressible reasons, we do not intend to collect, codify, and analyze group statistics of our own operative cases and those from other clinics.

We propose, rather, to approach the subject of pyloroplasty and gastroduodenostomy in this brief consideration, from an entirely different angle, namely that of anatomy and physiology. Suffice it to say on the statistical basis, that our results with these types of operation compare favorably with those figures compiled elsewhere on other types of operative procedures.

It is exceedingly elementary to draw attention to the fact that the stomach normally empties into the duodenum, not into the jejunum. Equally trite is the fact that normal stomach contents are acid and the duodenal contents alkaline, as are the jejunal. The difference lies in the fact that by usage from the time of inception of each individual human organism, the duodenal mucosa has become accustomed to the periodic introduction of acid materials, whereas the jejunal mucosa never has to face such problem or insult until the surgeon suddenly upsets the anatomic arrangements of nature. Until some bypass is artificially made to deliver stomach contents directly into jejunum, the latter's reaction is constantly on the alkaline side, due to the neutralization of acid effected in the duodenum by admixture with bile and pancreatic secretions. That this is important has been clearly brought out many times by different experimenters who cite the high percentage of duodenal ulcers obtained when these alkaline buffer fluids are experimentally shunted elsewhere. It would seem logical, therefore, to say that rapid and effectual neutralization of the acid stomach contents is an important factor in the prophylactic prevention of mucosal ulceration. That it is the sole etiologic consideration, we do not contend; but that it is an important one, which should not be overlooked, we insist. The natural place for this interaction to occur

is in contact with duodenal mucosa, which has been shown to be much less susceptible to damage, during the process, than jejunal mucosa. What would be more logical then than the operative maintenance of the normal anatomic gastro-duodeno-jejunal relationships whenever possible?

That interference with and slowing up of the normal emptying of the stomach tends to increase the acidity of its contents has been noted many times both clinically and experimentally by numerous observers. This is true whether the cause be spasm of the pyloric sphincter or an organic obstruction. The main exception to such a statement is in the presence of a neoplasm involving a considerable portion of the stomach wall, and, at least presumably, destroying many of the acid-forming glands. This fact furnishes one of the main differential diagnostic aids in distinguishing spastic or cicatricial obstructions from those of neoplastic origin, except in the very late stage with a tremendously dilated stomach.

Just as it is important to chew food adequately in order not only to break it up into easily digestible fragments, but also to mix the salivary juices with it, to start the proper digestion of certain of its component elements, so also is it important to have the food mass kept long enough in the stomach to have it thoroughly mixed with the gastric secretions. A stomach may empty too rapidly as well as too slowly for the good of the patient. The food may be insufficiently prepared for proper small intestinal digestion, just as it may become too acid for the good of the small intestinal mucosa. This factor must be borne in mind when performing any gastrointestinal anastomosis.

When any type of plastic operation is used at the pylorus, it involves cutting the sphincter, and hence, at least theoretically, putting it out of commission. This would seem to induce an immediate and too rapid emptying of the contents of the stomach into the duodenum. Actually, however, such is not the case. The emptying time of

the stomach remains somewhat prolonged for several months, usually gradually returning to within normal limits in about four to six months following the Finney type of pyloroplasty. The exact mechanism of this mild retardation we cannot give. Entirely parallel with this, however, is a persisting mild hyperacidity which tends to return to normal along with the emptying time. By this statement, we do not mean that the very slow emptying and high grade hyperacidity of a marked pyloric stenosis are maintained; such time and acid level will be materially lowered immediately, but may not return to entirely normal limits for some months.

With the ordinary gastrojejunostomy, either anterior or posterior, the rapidity of the emptying is dependent upon two factors: (1) the degree of patency of the pylorus and (2) the size and position of the new stoma. If the latter is situated in the most dependent portion of the stomach, and of a large size, and if at the same time the degree of stenosis of the pylorus is extreme, the stomach will empty very rapidly. On the other hand, if the pylorus is fairly patent, a large portion of the gastric contents will go through this natural way rather than through the new stoma, and the emptying time may be speeded very slightly, even in the presence of a large artificial opening.

The degree of acidity is affected comparatively slightly by the gastroenterostomy, and tends to remain in the neighborhood of the increased figures which preceded the operation. Where there has been a partial gastric resection, the degree of residual gastric acidity is largely dependent upon the amount of stomach removed. It has been shown that the acid-forming glands are found in the mid and fundic portions of the organ; very few if any are in the pyloric end. Therefore, it requires a fairly extensive resection materially to reduce the area of acid-forming mucosa, and a virtually complete gastrectomy to remove it all.

Many resections which are performed are of such limited extent—virtually no

more than a pylorectomy—that the acid manufacturing powers of the stomach are affected little if at all. Under such conditions if a gastroduodenal anastomosis is employed—either end-to-end as in Billroth I, or we believe better still, end-to-side as in Haberer-Finney—this acid is introduced immediately into the presence of the alkaline bile and pancreatic juice for neutralization, while still contained by mucosa accustomed to this function. If on the other hand, a gastrojejunal anastomosis of the Reichel-Polya or Roux type is employed, the neutralization must take place over the jejunal mucosa, which is entirely unaccustomed to such function. If, in addition, as is sometimes advocated, an enteroenterostomy has been made between the afferent and efferent limbs of jejunum, the alkali available for neutralization at the site of the stoma is further reduced, with a corresponding increase in the incidence of marginal or jejunal ulcer at the stoma. In the more extensive gastric resections, where sufficient of the acid-forming area has been removed to reduce the acidity permanently to normal or below, this objection does not hold, but here a mechanical one does crop up.

No matter how much stomach is removed, if that portion remaining is anastomosed to duodenum—whether end-to-end or end-to-side—it will maintain an essentially transverse position, such as originally existed. In such position it makes little difference what the size of the new anastomotic opening may be, so far as the rapidity of emptying is concerned, providing it is as great as the diameter of the duodenum. In the final analysis, the maximum possible is the caliber of the single efferent limb of duodenum, even though the full size of the cut end of the stomach be employed in a lateral anastomosis to the stump of duodenum, making a stoma 3 or 4 inches in length.

On the other hand, where the stump of the stomach is anastomosed to a loop of jejunum, whether it be brought up in the antecolic or in the retrocolic position, the

direction of the axis of the remaining portion of the stomach is immediately altered to an essentially vertical position. This allows gravity to hasten the emptying of the food contents from the stomach into the jejunal loop too rapidly, unless the size of the stoma is limited by the reduction of the open end of the stomach before anastomosis is performed. Bear in mind the fact that the loop of jejunum is composed of two limbs, not just one as in the duodenal anastomosis, and therefore the ultimate size of the stoma is not limited by the caliber of the jejunum, but by double that size. At least theoretically, and we believe frequently practically as well, if the food contents of the stomach are extruded too rapidly for the single efferent limb of jejunum to take care of all, the rest of the material backs up in the afferent loop sufficiently at times to institute the so-called vicious circle and cause real trouble. If the size of the stoma be reduced sufficiently to guard against this during the immediate post-operative period, it is quite possible that the further reduction due to inevitable contraction of scar tissue may eventually so diminish the caliber as to give more trouble.

There is one other point to which we would refer that concerns certain technical difficulties and potentialities. As regards any form of pyloroplasty or gastroduodenostomy, the ability properly to employ it is directly dependent upon the ability properly to mobilize the duodenum. For a pyloroplasty this means principally the first and second portions; for a gastroduodenostomy of the end-to-end (Billroth I) type, the same; but for the Haberer-Finney end-to-side, or the Jaboulay subpyloric side-to-side, mainly the second and third portions. One must be able to approximate without tension the two sides, gastric and duodenal, of the projected anastomosis to insure a good functional result.

The mechanics of duodenal mobilization have been covered fully in a recent article, and we will not detail them again here. Suffice it to say that in a majority of

instances this can be adequately and relatively easily done. Once the anastomosis has been made, there is practically no chance for mechanical trouble, provided the ostium is large enough, both for the immediate needs and to allow for the scar contraction which is bound to take place. The danger of kinking is eliminated by the fixed position of the remaining undisturbed portion of duodenum. The possibility of constriction by a contracting or badly placed leaf of mesentery is non-existent. There can be no backing up of stomach contents into a blind afferent bowel segment, because there is but one limb of bowel involved, and that efferent; if it was adequately patent before the anastomosis, it will remain so after it.

If the pylorus and first portion of the duodenum are so bound down with scar tissue of a chronic ulcer, or too densely attached to under surface of liver and common duct to be properly freed; or if the seat of an ulcer, perforating into and intimately involving the head of the pancreas behind, interferes with proper mobilization for the performing of a pyloroplasty or prohibits a resection; then quite frequently one can still mobilize the second and third portions to allow of a subpyloric Jaboulay type of gastroduodenostomy, which has all the advantages referred to above. Incidentally, this is an operation which in our opinion is far too seldom used, which is simple to perform, and which accomplishes everything that a gastrojejunostomy does without many of the latter's objectionable features.

Now as regards the technical and mechanical side of any type of gastrojejunostomy, there are a good many considerations. If there is to be a retrocolic or posterior approach, there may be the difficulty of a short or excessively fat mesentery of the transverse colon, and troublesome bleeding if a vessel escapes and retracts back between its leaves. There is the danger of constriction of the stoma if this mesocolon is not sutured far enough up on the stomach, and the possibility of its

forming an hour-glass constriction of stomach if sutured too far up. Or if not anchored sufficiently, front and back, the hazard of another loop of gut slipping up through the defect and becoming strangulated. There is the still constant argument of short or no-loop as opposed to long loop, and iso- as opposed to anti-peristaltic presentation of the loop for anastomosis. All of which is proof of the fact that there can and does occur a kinking of either afferent or efferent bowel limb, or both, at times, and when it does occur it is generally a serious complication.

If there is to be an anterior or antecolic approach, how long shall the loop be, shall it perforate, split, or cradle the great omentum, and shall there be an additional enteroenterostomy between the afferent and efferent jejunal limbs? All these are debatable questions, and are kept alive because results are not sufficiently satisfactory. There would seem to us to be potential mechanical difficulties far in excess of the simple mobilization of the duodenum where such is possible. We will grant that it is not feasible in 100 per cent

of cases, but we insist that it is in far many more instances than where this procedure is thought of or attempted.

In conclusion, we cannot do more than again urge surgeons to review in their own minds the pros and cons of the operative procedures available in dealing with lesions of the stomach, to familiarize themselves with the advantages, disadvantages, and difficulties of each, so that they may be in a position to use that particular type of operation best suited to each case which comes under their care. It would seem obvious that no one method of attack would be suitable in every case. It would seem desirable, where possible, to maintain nature's normal anatomic and physiologic relationships, and to avoid alteration of these except where such a course is really absolutely necessary.\*

\* No extensive bibliography will be appended here. Those who are interested in the physiologic, anatomic, and technical considerations involved in this article are referred to two articles and their appended bibliographies, recently published:

DEBAKEY, M. The physiology of peptic ulcer. *Surgery*, 2: 653; 1937.

FINNEY, J. M. T., JR. Pyloroplasty and gastroduodenostomy. *Surgery*, 2: 738, 1937.



# INDICATIONS FOR AND END RESULTS OF SURGERY IN THE TREATMENT OF DUODENAL ULCER

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IN 1922, 35 per cent of the patients with duodenal ulcer seen at the Cleveland Clinic were subjected to surgical operations. In 1937 only 5 per cent of the patients with duodenal ulcer required surgical treatment. In the past fifteen years, therefore, we have become seven times more conservative in recommending operative treatment for duodenal ulcer.

This trend toward the conservative management of duodenal ulcer is the result not only of the superior methods of medical management that the gastroenterologist now has at his disposal, but also of the experience gained in following more than 2600 patients with duodenal ulcer, many of whom, especially in the earlier days, were subjected to surgical operations.

An analysis of the results in 100 consecutive cases of duodenal ulcer treated by surgery indicates that our growing conservatism and desire to manage these patients on a medical regimen is well justified. Yet we should like to emphasize again that certain of the complications of duodenal ulcer such as perforation, persistent or recurrent obstruction, and recurrent hemorrhage, demand surgical intervention and that the best interest of the patient will be served if surgery in these cases is not delayed.

## ANALYSIS OF 100 CONSECUTIVE CASES OF DUODENAL ULCER TREATED BY SURGERY

The indications for operation in 100 consecutive cases of duodenal ulcer treated by surgery are given in Table I.

The operations performed for the relief of these symptoms are shown in Table II.

Seventy-four per cent of these patients were followed for from six months to ten

TABLE I  
LEADING SYMPTOMS BEFORE OPERATION

	Per Cent
Pain.....	54
Obstruction.....	26
Bleeding.....	12
Acute perforation.....	8

years after operation, an average follow-up period of forty-six and one-half months.

TABLE II  
OPERATIONS PERFORMED

	Per Cent
Posterior gastroenterostomy.....	72
Resection of stomach (posterior polya in the majority of cases).....	14
Closure of perforated ulcer.....	6
Pyloroplasty.....	5
Posterior gastroenterostomy and plication of perforated ulcer.....	2
Anterior gastroenterostomy.....	1

## RESULTS FOLLOWING POSTERIOR GASTROENTEROSTOMY

As indicated in Table I, posterior gastroenterostomy was the operation of choice in seventy-two of the 100 cases. In this series, there were three hospital deaths, a mortality rate of 4.2 per cent.

In sixteen cases, the gastroenterostomy was performed for obstruction. Fourteen, or 87.5 per cent, of these patients obtained complete relief of all symptoms referable to

TABLE III  
RESULTS OF POSTERIOR GASTROENTEROSTOMY FOR OBSTRUCTION  
Sixteen Cases (Post-Operative Deaths Not Included)

Result	Number of Cases	Per Cent of Total Cases
Completely relieved.....	14	87.50
Partially relieved.....	1	6.25
No relief.....	1	6.25
Total.....	16	100



ulcer or obstruction. One patient (6.2 per cent) obtained partial relief, and one patient obtained no relief. (Table III.)

The end results of gastroenterostomy in thirty-three patients whose outstanding complaint was pain were less satisfactory than when the leading symptom was obstruction. In 60.6 per cent of the cases, complete relief of symptoms was obtained, but it should be noted that a few of the patients found it necessary to remain on a guarded diet in order to avoid a recurrence of symptoms. Partial relief was obtained in 18.2 per cent, and 21.2 per cent failed to obtain any striking relief of symptoms unless they adhered to a rigid medical regimen. (Table IV.)

TABLE IV  
RESULTS OF POSTERIOR GASTROENTEROSTOMY  
FOR PAIN  
Thirty-three Cases (Post-Operative Deaths Excluded)

Result	Number of Cases	Per Cent of Total Cases
Completely relieved.....	20	60.6
Partially relieved.....	6	18.2
No relief.....	7	21.2
Total.....	33	100

The results of gastroenterostomy for pain must therefore be classified as being good only in conjunction with dietary management of the ulcer. Operation alone cannot be considered to effect complete and permanent relief of pain in all cases. The results in the older patients were distinctly better than in the younger, permanent relief of symptoms being 20 per cent more common in patients over 45 years of age than in those under 45.

In five cases, posterior gastroenterostomy was performed because of a history of recurrent hemorrhage from a duodenal ulcer. Four of these five patients had no recurrence of the hemorrhage and in one case there was a recurrence of the bleeding. (Table v.)

TABLE V  
RESULTS OF POSTERIOR GASTROENTEROSTOMY  
FOR BLEEDING  
Five Cases (Post-Operative Deaths Not Included)

Result	Number of Cases	Per Cent of Total Cases
Completely relieved.....	4	80
No relief.....	1 (recurrence of hemorrhage)	20

The end results of gastroenterostomy for obstruction, pain, and bleeding are summarized in Tables III, IV, and V.

It is clear from the foregoing data that the best results following posterior gastroenterostomy are obtained when obstruction is present. When gastroenterostomy is to be performed for pain or hemorrhage, it must be with the understanding that the patient will continue to follow a guarded diet and will consider the gastroenterostomy as an adjunct to medical management. It has been our experience, however, that ulcers which are intractable to medical therapy before operation will usually yield readily to treatment after gastroenterostomy is performed.

#### GASTRIC RESECTION

The post-operative mortality rate from gastric resection has been approximately three times as great as that from gastroenterostomy. Gastric resection is therefore an operation which, in the absence of special indications, should not be advised for a disease which is essentially benign.

In addition, although gastric resection effects a cure of the ulcer in the great majority of cases, it has been our experience that in some cases this procedure replaces the symptoms of ulcer with other types of distress which may be equally annoying to the patient. Thus, 20 per cent of the patients having gastric resections complained of gastric symptoms comparable in severity to those produced by the ulcer which had been resected and in

one instance hemorrhage from a gastrojejunal ulcer occurred. It is doubtless a satisfaction to the surgeon to have cured the duodenal ulcer, but the patient cannot enjoy this satisfaction if he continues to experience pain. Many of the patients whose stomachs had been resected were forced to follow a guarded diet in order to be free of symptoms and hence the post-operative course of the patients with gastric resections, although the ulcer may be cured, may entail as much attention to diet and as much gastric distress as is reported to occur in patients subjected to more conservative procedures. The greater mortality rate associated with gastric resection should influence the decision, wherever possible, in favor of the more conservative measures.

#### DISCUSSION

From the foregoing data, it is clear that gastric surgery, and particularly the more radical and hence more dangerous types of gastric surgery, although perhaps curing the ulcer, do not always result in the complete and permanent relief of gastric distress. In addition, as Gray<sup>1</sup> has stated, "Promiscuous resection of the stomach for duodenal ulcer does not seem to be warranted. The risk of a fatal outcome with this procedure is probably greater than is the possibility of obtaining an unsatisfactory functional result or a recurrent or anastomotic ulceration with the more conservative surgical measures." For these reasons, we have become progressively more conservative in recommending radical surgery for patients with duodenal ulcer.

Although we now believe that, with careful medical management, over 95 per cent of the patients with duodenal ulcer can carry on their normal activities in safety and comfort, there are certain complications of peptic ulcer which demand surgical intervention.

The first of these is *acute perforation*. The perforation should be closed as soon as possible and no further surgery should be attempted at this time. In our experi-

ence, the mortality rate following gastroenterostomy and closure of a perforated ulcer has been unjustifiably high. We believe with Roscoe Graham<sup>2</sup> that in the presence of a perforated ulcer the surgeon should "deal in the most simple manner only with the lesion which creates the hazard to life." Graham records thirty-six consecutive operations for perforated ulcer without a death.

*Pyloric obstruction* may occur as the result of inflammatory edema, spasm, or actual cicatricial stenosis secondary to a duodenal ulcer, and often will be completely relieved by skilful medical management with the patient at rest in the hospital for a few days to two weeks. If, however, no relief is obtained or if the obstruction recurs, posterior gastroenterostomy will give prompt and permanent relief with maximum safety. Obstructing duodenal ulcers rarely recur after gastroenterostomy. Hence, in cases with obstruction, resection of the ulcer or resection of the stomach are unnecessary and, in view of the increased mortality rate associated with these procedures, they are undesirable.

The mortality rate in patients with bleeding duodenal ulcer treated conservatively is considerably higher than has been generally recognized. The recent studies of Kiefer<sup>3</sup> show that the mortality rate in this condition is approximately 5 per cent. As Allen and Benedict<sup>4</sup> have shown, this mortality rate increases with advancing age and with each succeeding hemorrhage. Thus in patients beyond middle age who have previously had one or more hemorrhages, the case fatality is higher than the post-operative mortality rate of a conservative operation for duodenal ulcer. In the Lahey series,<sup>5</sup> it has been observed that, whereas medical management succeeded in 60 per cent of the cases of bleeding ulcer seen after the first hemorrhage, only 15 per cent of the patients remained well on medical management when more than one hemorrhage had occurred. *Recurrent hemorrhage* therefore affords a sound indication for prompt surgical intervention.

In older patients and particularly in women, conservative surgery gives excellent results in the treatment of bleeding ulcer. A gastroenterostomy or pyloroplasty with local excision of the ulcer will usually effect a permanent cure of the bleeding. Occasionally in younger men, with high free acid values, and particularly in those who have bled a number of times in spite of medical management, it is perhaps wiser to resect the stomach, but it should be remembered that even extensive gastric resections do not give absolute protection against the development of a marginal ulcer. Extensive operations are contraindicated in the presence of recent bleeding and it is wiser, when the patient is exsanguinated, to replace the lost blood by transfusion, excise the ulcer, and perform a pyloroplasty, as recommended by Judd.<sup>6</sup>

An ulcer which produces *persistent pain* that is unrelieved by skilful medical management, and is severe enough to interfere with the patient's activities, thereby becomes a surgical problem. As has been noted previously, approximately 60 per cent of the patients on whom conservative operations, such as pyloroplasty or posterior gastroenterostomy, were performed for the relief of pain obtained complete and permanent relief of symptoms. An additional 18 per cent were partially relieved and could be kept comfortable provided they followed a reasonable medical regimen. The results of conservative operations are not therefore so unsatisfactory, particularly when we remember that 20 per cent of the patients having gastric resections continued to complain of more or less severe gastric distress if they were not careful in respect to their diet.

In this series of seventy-two gastroenterostomies, the incidence of known gastrojejunal ulcer has been only 1.4 per cent. When the increased mortality rate of gastric resection is taken into consideration, and when the incidence of gastrojejunal ulcer following gastroenterostomy is only 3 per cent in the large series of gastroenterostomies that have been performed

at the Mayo Clinic,<sup>7</sup> and when the wide experiences of such surgeons as Judd and Balfour led them to conclude that from 85 to 90 per cent of the patients with duodenal ulcers treated by conservative operations such as gastroenterostomy or pyloroplasty were improved, we must weigh the problem seriously before recommending more hazardous procedures for the treatment of an essentially benign disease.

Trimble and Reeves<sup>8</sup> report a series of 150 posterior gastroenterostomies performed at the Johns Hopkins Hospital with a 2 per cent mortality rate. A careful follow-up showed 74 per cent of these patients to be well and free of symptoms referable to ulcer. The incidence of marginal ulcer was only 0.8 per cent.

Strauss,<sup>9</sup> in discussing the post-operative course of forty-four patients subjected to gastric resection for duodenal ulcer, reports the occurrence of one gastrojejunal ulcer and failure to relieve the patients of gastrointestinal symptoms in 16 per cent of the cases. When the mortality rate in gastric resections for peptic ulcer is quoted at 11.8 per cent by surgeons of as wide experience in gastric surgery as Marshall,<sup>10</sup> and when Walters<sup>11</sup> states that the mortality following this operation in the hands of experienced surgeons is from 7 to 15 per cent, strong indications must exist before it can be recommended.

In our opinion, gastric surgery for duodenal ulcer should be avoided if possible. When necessary, a pyloroplasty or a gastroenterostomy affords excellent chances for a permanent cure with a minimum risk. All patients subjected to surgery should remain under medical supervision and should continue to consider themselves as ulcer patients. If these measures fail, resection of the stomach can still be performed. Only in the hands of surgeons of such skill and experience as Roscoe Graham,<sup>2</sup> whose mortality rate in a large series of gastric resections is 3 per cent, does so radical an operation seem to be justified in the treatment of a benign disease.

In a small series of carefully selected cases in the majority of which gastric operations had been performed previously for the relief of symptoms of ulcer, Dr. Crile, Sr. has denervated the adrenal glands and severed the splanchnic nerves. This procedure brings immediate relief of the symptoms referable to ulcer and in some instances has afforded remissions lasting throughout the period of follow-up and as long as six years. In other cases, however, the results after the first year or two have been less satisfactory. The status of this problem is not yet definitely settled and it will remain for the future to tell whether or not surgical intervention in the sympathetic nervous system will provide a means of controlling selected cases of ulcer that have not improved with medical treatment.

Since a high strung temperament, overwork, and worry constitute the background upon which ulcer is generated in many cases, it is essential, in conjunction with surgery and medical management, therefore, that the patient be taught discipline and self-control as a means of minimizing the background of nervous tension upon which peptic ulcer is generated.

#### SUMMARY

1. Duodenal ulcer is essentially a medical problem and surgery is indicated only for its complications, i.e., obstruction, recurrent hemorrhage, perforation, and penetration with intractable pain.

2. Conservative operation such as pyloroplasty with excision of the ulcer or gastroenterostomy have given good results with a low mortality rate.

3. The mortality rate associated with gastric resection is approximately three times as great as that of the more conserva-

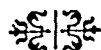
tive operations and the prospects of complete relief of gastrointestinal symptoms are not much greater than with the more conservative procedures.

4. In view of the relatively good results obtainable by conservative surgery, we do not believe that more radical operations should generally be applied in the treatment of an essentially benign disease.

5. When duodenal ulcer is complicated by hemorrhage, obstruction, or perforation, the combination of conservative surgery and skilful medical management both before and after operation will offer more for the patient than either form of treatment alone.

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# DIVERTICULA OF THE PROXIMAL INTESTINE: DUODENUM AND JEJUNUM

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**D**IVERTICULA of the proximal intestine, although comparatively infrequent, have assumed a more and more important place in the differential diagnosis of lesions of the gastrointestinal tract. Before 1920 the recognition of these outpouchings was made only at autopsy. At this time Case is given credit for giving the first roentgenographic description of the lesions of the small intestine, and although the last two decades have brought improvement in roentgenographic diagnosis, perfection in diagnosis is still wanting.

## DIVERTICULA OF DUODENUM

Diverticulosis of the duodenum was discovered at autopsy and reported by Chomel in 1710. These lesions were classified as surgical curiosities. During the latter part of the last century, accurate anatomic descriptions were given by Virchow, Graser, and Fischer, and, their clinical significance was brought to the attention of the medical profession by the papers of W. J. Mayo, Beer, Moynihan, Drummond, Mummery and others.

Harley, in 1875, and Cole and Roberts, in 1920, reported diverticula of the duodenum containing gallstones, while Terry and Mugler and C. M. Watson reported instances of enteroliths in diverticula of the jejunum causing intestinal obstruction. Morrison and Feldman reported a primary carcinoma in a diverticulum of the duodenum.

*Pathology and Anatomy.* The diverticula of the duodenum may be classified as primary and secondary or as congenital and acquired. Fletcher and Castleden feel that secondary diverticula are due to traction of some neighboring inflammatory process,

such as an ulcer, and invariably occur in the first part of the duodenum; these are somewhat rare. The primary or congenital type is more common; these never occur in the first part of the duodenum, but are occasionally seen in the third and fourth portions. In the majority of instances (75 per cent) the diverticula are seen springing from the concave inner aspect of the descending limb, never far from the ampulla of Vater, and lying in close relationship to the head of the pancreas. These outpouchings are often multiple.

The histologic structure of the primary type is frail and, when dissected out from the areolar tissue which surrounds them, they are collapsed, thin-walled, with the layers consisting of mucous membrane, submucous coats of the intestine and a few bundles of muscle fibers which fade out as they reach the fundus. The opening in the bowel varies in size, but it may be large enough to admit the finger tip. Such an opening would favor the entrance of intestinal contents, but the absence of muscle would create stasis within the pouch. Melville stated that no inflammatory reaction can be found about the necks of these sacs and in reality they are herniations of mucous and submucous coats through the muscular coat. The acquired or secondary diverticula are, on the other hand, pouches with three complete layers. Histologic examinations show inflammatory reactions around the necks of these diverticula.

Fletcher and Castleden stated that these diverticula are hernias of the duodenal wall, and the close relationship of their necks to the blood vessels which pierce the concave aspect of the bowel, or to the

entry of the common duct, suggests a gradual developing protrusion through a weak spot thus formed. Thus, although occasionally found in the young, they are more frequently found as age advances. Rare instances of inflammation and perforation of these sacs have been recorded. Other cases may be associated with cholangitis and pancreatitis. Melville reported a case associated with congenital absence of the gall-bladder.

*Incidence.* Although Case is given credit in this country for having first diagnosed diverticulosis of the small intestine by the roentgenogram, Melville credits Forssell and Key, in 1915, for the first roentgenologically diagnosed diverticula of the duodenum. Case reported an incidence of 1.2 per cent in 6,847 routine roentgenographic examinations; Andrews, in 1921, 12 per cent in 2,200; Larimore and Graham in 1927, 0.5 per cent in 3,446; and Edwards in 1935, 0.97 per cent in 2,247 examinations. McMullan found 1.5 per cent; Spriggs and Marxer 3.8 per cent, and Cryderman 5.19 per cent. Odgers quoted these five authors as having found 2.5 per cent in 11,470 examinations. Lawson found thirty-six cases out of 2,250 consecutive roentgenologic examinations of the gastrointestinal tract.

The incidence, as found by autopsy, was: 3.5 per cent in 1,367 examinations (Linsmayer 1914); 2.2 per cent in over 900 (Nagel, 1925); 14.2 and 16 per cent (Baldwin and Grant).

Melville stated that diverticulosis of the duodenum is not an uncommon condition. Wilkie, in 1913, recorded three cases and noted that sixty-eight were reported in the literature up to that time.

Horton, in 145 cases, found 83 per cent of the diverticula in the second portion of the duodenum on the lesser curvature and adjacent to the ducts, while Edwards reported 73 per cent in this region in 280 cases. The sac may lie against, in front of, behind or within the pancreas.

Diverticula of the third portion of the duodenum resemble those of the second in

structure and lie in close association with the pancreas, but since they open downward are more difficult to fill with barium. Roughly, 10 to 15 per cent occur in the third portion of the duodenum.

Authors differ as to whether diverticula are more common in men or in women, but they agree that they are rarely seen before the age of 30 and the majority between the ages of 50 and 60 years.

*Diagnosis.* The symptoms of diverticula of the duodenum are not clear cut, hence not of great aid in diagnosis. There may occur associated biliary tract, pancreatic or gastric lesions, the symptoms of which entirely cover up the indefinite symptoms of the diverticula. The upper abdominal symptoms that are present are indications for further gastrointestinal study. The roentgenogram has the greatest possibilities for diagnosis.

Routine fluoroscopic examination should include the upright, the supine and the modified Trendelenburg position, the latter being the only position in which an occasional diverticulum of the third portion of the duodenum can be filled with barium. The duodenum may be distended with barium by blocking the duodenojejunal junction with pressure of one hand while the other sweeps the barium from the stomach through the pylorus. In obscure cases a duodenal tube may be utilized to distend the duodenum.

Pendergrass emphasizes the presence of peristaltic waves and serrated outlines in redundancies and their absence in diverticula, demonstrated by palpation in the right oblique position under the fluoroscope and by the study of serial films; also the necessity of taking a plain film before the barium is given, to eliminate fecaliths, stones and calcified glands. Delayed films may reveal retained pockets of barium within the diverticula after the bowel is empty. A distended ampulla of Vater must be distinguished from a small diverticulum. He believes that the ampulla empties more rapidly, is usually smaller and presents a comma-shaped, tubular,

collar button, dumb-bell or dimpled appearance. Melville, in reporting his case of congenital absence of the gall-bladder with associated duodenal diverticulosis, stated there was not sufficient stress laid on the possibility of duodenal diverticulosis being responsible for the symptoms. He concluded that in all cases where gall-bladder pathology is suspected, examination of the duodenum should be made.

**Treatment.** Guthrie and Sharer stated that medical treatment of diverticulosis of the small bowel should be limited to those in which the outpouchings are small and the symptoms mild. Rest, diet, avoidance of large meals and gentle massage may give relief. Surgery is indicated in the large type or when symptoms persist. Inversion of the sac may lead to obstruction, and it is preferable to excise the sac and repair the defect at right angles to the long axis of the bowel. Those with small bases may be resected and the stump inverted. Gastroenterostomy or resection of a length of the bowel may be required.

Guthrie and Sharer reported Case II after surgical procedures had been carried out; Case I is reported here for the first time.

#### CASE REPORTS

**CASE I.** A white female, 50 years old, came to the clinic November 29, 1935. Her chief complaint was vomiting and she stated that she had had stomach trouble for about twenty years, with gas, vomiting and pain. In March of 1935 she developed an acute attack of gas, pain and vomiting which continued until May, 1935 when, at another clinic, a posterior gastroenterostomy was performed for a duodenal diverticulum. Following this operation she was relieved of vomiting until about three weeks before admission at this clinic. At that time she developed acute right upper quadrant pain, backache and vomiting; she was considered to have acute cholecystitis at another hospital and was treated conservatively. Since that time she had vomited nearly every day—usually about one hour after meals. The vomitus on each occasion consisted of undi-

gested food and bile. She had lost considerable weight and strength.

Examination at this hospital was essentially negative except for diastasis of recti and moderate tenderness to the right and above the umbilicus. Laboratory findings upon admission showed a moderate secondary anemia, and the specimen of stool showed a slight reaction for occult blood. Blood chemistry was within normal limits. Roentgenograms showed a rapidly emptying gastroenterostomy. The pyloric end of the stomach was narrowed and the duodenal cap was seen. The stomach did not appear to empty through the duodenum; therefore the diverticulum was not visualized.

Since the vomiting had been the same as previous to the posterior gastroenterostomy, it was decided that the diverticulum was still the cause for the vomiting. Accordingly, surgery was advised. On December 3, 1935, the patient was operated upon and a large diverticulum of the third portion of the duodenum was found lying in Treitz's fossa. The diverticulum was dissected free down to its neck and was ligated; it was then removed and the stump was cauterized. The stump was then inverted beneath a purse-string suture of linen. It was feared that a vicious circle might develop if the gastroenterostomy were left in place, and it was therefore dissected apart and the rents in the stomach and jejunum were closed by the usual method of intestinal suture.

The post-operative course was stormy and complicated by much abdominal distention and vomiting. These symptoms were easily controlled by the method of Wangensteen and, after the first twelve post-operative days, convalescence was rapid. The patient was discharged much improved on January 11, 1936.

This patient was seen at this Clinic on April 4, 1936 and on May 23, 1937 for other conditions unrelated to the above described illness. She was completely relieved of all her gastrointestinal symptoms.

**CASE II.** A female, 69 years old, came to the Guthrie Clinic on August 23, 1935, with a history of pain in the right side associated with vomiting during the preceding year. For four weeks she had vomited everything eaten. She had been constipated for thirty years.

A large movable mass was present in the right lower quadrant. The tip of the cecum

could not be filled when she was given a barium enema. Examination of the stomach showed a well defined diverticulum of the third part of the duodenum. (Fig. 1.)

Exploration, on September 7, 1935, revealed a carcinoma of the cecum which was resected and followed by a side-to-side anastomosis and by an enterostomy. Due to the condition of the patient, the duodenum was not explored at the time of the operation. She was discharged from the hospital October 12, free of symptoms and in good condition. She returned to the follow-up clinic in September 1937 and was found to be in excellent health.

#### DIVERTICULA OF THE JEJUNUM

The classification of diverticula in the jejunum is the same as for the duodenum. The congenital sacs are true diverticula and are made up of the same layers as exist in the normal intestinal wall. The acquired variety are herniations of the mucosa and the submucosa through the muscle layer; there being little or no muscle in their walls.

*Historical.* Sir Astley Cooper, in 1844, first described multiple pouches in the upper jejunum of a 65 year old man. In 1881, Sir William Osler recorded a case of a man 65 years old with fifty-five upper jejunal diverticula, varying in size from that of a cherry to that of a large apple. Other cases were described before 1900 by Virchow, Edel, Grassberger, Hanseln, Hanseemann, Hanau and Nichols. Klebs suggested that the pressure of fluid and gas in the intestine initiated the development of diverticula. It was Klebs who first noted the relationship between diverticula and blood vessels; he described the sites of entrance of the blood vessels through the intestinal wall as the points of least resistance. His belief that blood vessels caused a drag upon the mucous membrane has not been substantiated.

Graser, in 1899, considered venous congestion as a factor in causing the weakened points in the bowel wall. Fischer, in 1900, thought that chronic constipation, traction, gas pressure and chronic passive congestion were the cause of diverticula. In 1900 also,

Sudsuki suggested that degeneration of the connective tissue sheath of veins was important in the etiology. In 1904, Beer



FIG. 1. Well defined diverticulum of the duodenum.

reviewed the subject. Gordinier and Sampson, in 1906, reported a case which was probably the first recognized at operation. Their patient was a woman, 45 years old, who had suffered abdominal pain and tenderness, constipation, and had a history of having passed two enteroliths.

In 1918, Braithwaite discovered a case of diverticulosis of the small intestine at autopsy. There were about sixty diverticula, each of which coincided with a blood vessel which pierced the muscular wall. Associated with this condition was an aortic aneurysm with atheromatous healing which suggested to Braithwaite the parasymphilitic cause for the diverticulosis.

The first roentgenographic diagnosis was made by Case in 1920 and he reported two cases diagnosed by this method. The year following, Stetten reported a case of a man, 38 years old, with multiple diverticulosis of



the colon and two diverticula of the upper ileum, which he resected. These diverticula had been previously visualized by roent-

In 1924, Watson reviewed the literature and was able to find a record of twenty-nine previously reported cases. He added



FIG. 2. Portion of specimen from Case 1. The relationship of blood vessels to the diverticula is shown. The clamp and forceps identify the blood vessels. There may be more than one vessel in relation to the large diverticula.



FIG. 3. Another portion of the specimen from Case 1. Multiple diverticula of varying sizes are shown with their relationship to blood vessels either side of the mesenteric line. A bilobed diverticulum is shown at the extreme left, while at the extreme right one large outpouching extends across the mesenteric line. This large one is probably the result of fusion of two smaller diverticula originally on either side of the line.

genologic studies. Also, in 1921, Cook and Hunt reported two cases and MacKechnie reported one case. The histories in their cases had the indefinite symptomatology observed in most such patients. McWilliams reported a case this same year occurring in a man 71 years of age and presenting the symptoms of an acute abdomen.

one case of diverticula occurring in a man aged 73 years. He had operated upon this patient and found multiple diverticula with one of the largest pouches containing an enterolith.

Subsequent to this review, cases were reported by Sheppe (1924); Rothschild (1925); Heidecker (1928); Miller (1931); Tengwall (1931); Boling (1931); Swanberg

(1932); Erdmann (1932); and Duckett (1932). In 1937, Guthrie and Hughes reviewed the literature on diverticula of the

upon roentgenologic studies, but even this method is far from perfect.

*Incidence.* Case found an incidence of



FIG. 4. Five feet of resected jejunum from Case 1, showing about seventy diverticula of varied sizes.

small intestine and found that approximately 100 cases had been reported. They reported three additional cases. Shortly after this recent review and addition of case reports, Guthrie and Brown reported another single case which was diagnosed by roentgenologic studies and was proved by operation. Of these four cases reported from the Guthrie Clinic it was found that two had been diagnosed pre-operatively by roentgenologic studies—a percentage of 50. However, Guthrie and Brown found that only ten cases (10 per cent) of the approximate 100 cases had been diagnosed pre-operatively. Chapman concluded, from his review of the literature, that diagnosis of diverticulosis of the small intestine rests

0.1 per cent in 10,000 consecutive barium meal examinations, while at Johns Hopkins Hospital 0.5 per cent were found at autopsy. One case in 36,357 roentgenographic examinations of the stomach and duodenum was found by Rankin and Martin at the Mayo Clinic. These figures indicated that a constant vigil must be kept in order to find comparatively isolated cases. As to age and sex distribution, the series of fifty-two cases reported by Rankin and Martin gave a good index. In this group there were thirty-eight males with an average age of 55.6 years, with variation from 21 to 82 years of age.

*Pathology and Pathogenesis.* The structure, anatomically and histologically, of

diverticula of the jejunum is somewhat the same as that described for diverticula of the duodenum. The same factors which

ent. The high intestinal ileus may quite rightly be thought of as a very advanced degree of irregular contractions. The second



FIG. 5. Roentgenogram of Case 11, showing the large diverticulum of the proximal portion of the jejunum.

play a part in production of diverticula of the duodenum are at work in the production of outpouchings in the jejunum. Guthrie and Hughes concluded from their review that all authors agree that the two major factors are the point of decreased resistance at the site the blood vessel enters the bowel and the increased intra-intestinal pressure. Edwards' explanation is the most logical and is substantiated by laparotomy and roentgenologic observations.

Guthrie and Hughes postulated that the three cases they reported were probably sufferers from irregular intestinal contractions. The first patient developed a duodenal ileus and died the sixth post-operative day. Figures 2 and 3 show portions of resected jejunum with the diverticula pres-

ent. The high intestinal ileus may quite rightly be thought of as a very advanced degree of irregular contractions. The second patient developed a vicious circle after a posterior gastroenterostomy which had been correctly done, as shown by the second operation. In the third case, an otherwise perfect convalescence was marred by a temporary high intestinal ileus. These findings in the three cases support the theory of Edwards that irregular intestinal contractions are an etiologic factor in the formation of diverticula, inasmuch as some form of functional derangement revealed itself in the upper intestinal tract associated with the presence of jejunal diverticula. The fourth case from this clinic recovered without complication since a cholecystectomy was done for cholelithiasis and work on the diverticula was limited to exploration.

*Symptomatology and Diagnosis.* The recent review by Guthrie and Hughes showed that vague abdominal pains, flatulence,

to illustrate the varied histories obtainable from patients with diverticulosis of the small intestine:



FIG. 6. Roentgenogram of Case III, showing retained barium in several diverticula five hours after the barium meal was taken.

indefinite digestive symptoms, hematemesis in some cases, and bleeding from the bowel were symptoms and findings of note to be considered in the diagnosis of this condition. Rankin and Martin, in their review, found only one case with a history of tarry stools. Of course, concurrent diseases of the gastrointestinal tract cloud the history seriously in diverticulosis cases. Such symptoms present in a patient should naturally lead to the use of the roentgen examinations for diagnosis if the pre-surgical and pre-autopsy diagnoses are to be improved.

The summary of the four cases reported previously from this clinic are included here

#### CASE REPORTS

**CASE I.** A white male, 70 years old, entered the clinic May 18, 1929, complaining of loss of weight and strength for one year. During the month preceding admission he developed diarrhea; he had had no previous gastric or bowel trouble. The stool contained mucus but no blood. A few days prior to admission he had vomited several times. He had lost weight from 215 pounds to 155 pounds (his weight at examination). The physical findings at this examination were: several bad teeth, enlarged tonsils, blood pressure systolic 122, diastolic 80, several large external hemorrhoids and a moderately enlarged prostate.

Laboratory findings were negative except for lack of free acid in the stomach and occult

blood in the stool. Roentgenographic examination showed the stomach to be high-riding with considerable narrowing of the pylorus, but giving no evidence of retention or ulcer.

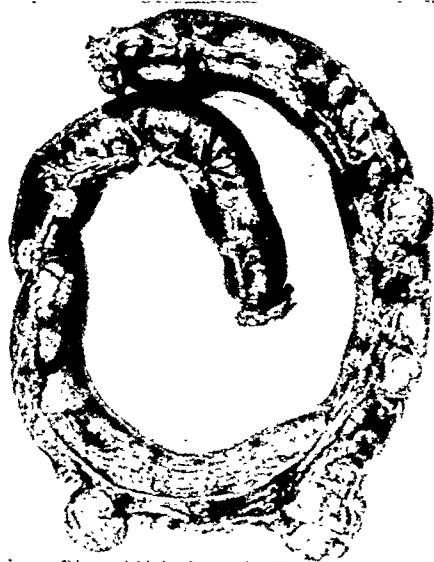


FIG. 7. Specimen of resected jejunum from Case III. The diverticula extend from one side of the mesenteric line. Dissection of the mesentery showed several smaller diverticula.

A pre-operative diagnosis of carcinoma of the stomach was made and operation was advised. At operation on May 29, 1929, many (seventy) diverticula of the jejunum (Fig. 4) of varied sizes were found. These began 4 inches from the ligament of Treitz and extended down the jejunum 5 feet. The involved gut was resected and an end-to-end anastomosis was done. The patient died on the sixth post-operative day with the clinical picture of high intestinal obstruction. Autopsy showed no evident obstruction or infection to account for the death.

CASE II. This patient was a white male, 60 years old, with an admission complaint, on December 28, 1934, of abdominal pain after meals and at night, relieved by soda and vomiting. During the two months previous to admission he had become progressively worse.

Physical examination gave no clue to the diagnosis. There was a slight secondary anemia, shown by the blood count, and 3.5 per cent sugar in the urine. Roentgenographic studies showed the stomach high and to the right with small ragged narrowing of the pylorus extending into the base of the cap; this smoothed out easily. The portion of the jejunum immediately under the pylorus gave the appearance of a

diverticulum. (Fig. 5.) There was no retention at five hours. From the study, a lesion at the pylorus was suspected.

A diagnosis of peptic ulcer with possible malignancy, complicated by diabetes mellitus, was made. The diabetes was controlled and treatment by diet and belladonna was prescribed for the ulcer. Operation was advised.

The patient returned to the hospital January 5, 1935 and was prepared for operation on January 9, 1935. At operation a chronic ulcer was found in the duodenum and a gastroenterostomy was performed. No diverticulum was found at this time. Two weeks following operation the patient developed vomiting associated with epigastric distress. Roentgenograms showed evidence of an obstruction in the jejunum distal to the anastomosis.

A second operation was performed three weeks after the first, and a large diverticulum was found in the middle of the proximal loop of the jejunum; two other diverticula were found below this one. The gastroenterostomy was patent. The two upper diverticula were resected and an enteroenterostomy was done. The patient improved and was discharged after four weeks. Examination two years after operation showed the patient to be well.

CASE III. A white male, 54 years old, entered the hospital on February 8, 1936, with the complaint of hemorrhage from the bowel on several occasions. For a year previous to admission he had had attacks of mucous diarrhea; six weeks before admission the diarrhea recurred, with large amounts of mucus and some blood present in the stools.

Physical findings at this time showed the patient to be pale and apprehensive; blood pressure was 170 systolic and 100 diastolic; there was a systolic murmur over the precordium. Abdominal examination was negative, but the rectum contained a mass of old blood. Laboratory studies showed some anemia. A transfusion was given February 10, 1936.

After slowly cleaning the gastrointestinal tract, several proctoscopic examinations were made, with negative findings. Barium enemas were given which showed spasticity of the rectal pouch and narrowing of the sigmoid. Air injection demonstrated no pathologic lesions. Roentgenograms of the stomach and intestinal tract were examined and delayed films showed retained barium in the small bowel, interpreted as diverticula. (Fig. 6.)

Operation on February 20, 1936, showed twenty-two varying sized, mesenteric diverticula of the jejunum, beginning 4 inches from the

normal limits. A diagnosis of chronic cholecystitis without stones was made and treatment was accordingly prescribed.

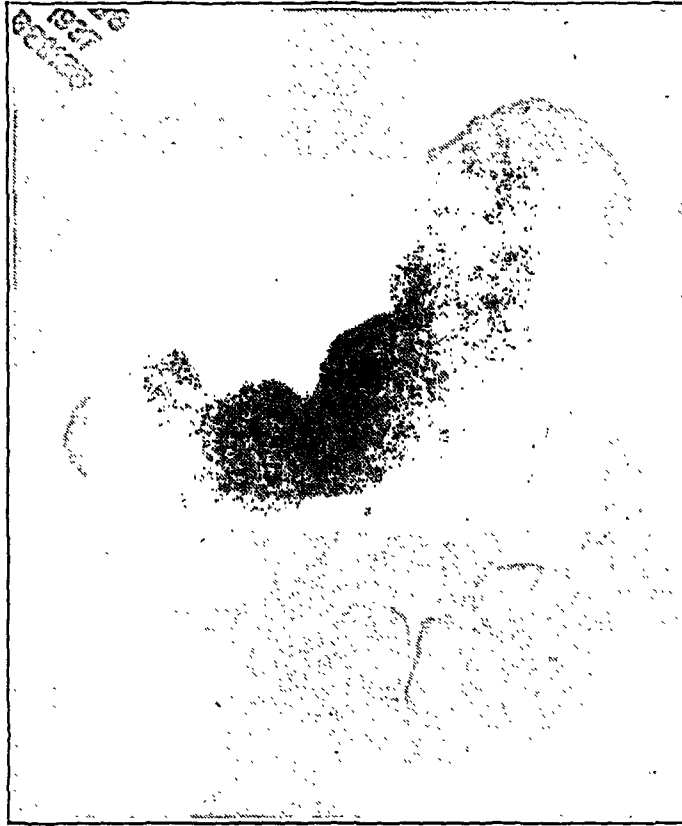


FIG. 8. Roentgenogram of Case IV. The stomach and duodenal cap were filled. The multiple diverticula of the jejunum were well filled with barium.

jejuno-duodenal junction and involving the next 23 inches. The involved area was resected and an end-to-end anastomosis was made. (Fig. 7.) After a rather stormy convalescence the patient was discharged from the hospital March 22, 1936. Two reports from the patient since that time show that he is well.

**CASE IV.** A white female, 59 years old, entered the hospital on August 14, 1931 with the chief complaint of regurgitation of food, belching and loss of 7 pounds of weight. The regurgitation began in May, 1931 and occurred after meals from one to three times a day. She had some epigastric pain three days before admission. She had an intolerance for acid and greasy foods which aggravated the symptoms. She had vomited, and the vomitus, on some occasions, contained blood, according to her doctor.

Examination at this time showed the abdomen to be obese, with tenderness present in the epigastrium. Laboratory tests and the Graham-Cole test of gall-bladder function were within

The patient was quite well until the spring of 1936 when she had developed severe pain in her left shoulder. In August 1936, she was awakened by severe pain in the epigastrium which radiated to her back. After three or four days in bed, she felt well again. In September and October 1936, she had pain in the left shoulder which was treated by twenty-two chiropractic adjustments. In November 1936, she spat up a large amount of material of coffee ground character, following which she was advised by her physician that she had an ulcer. Soda relieved the distress, but she noted no relationship of her symptoms to meals. She lost 15 pounds in three weeks. The patient changed physicians and a diagnosis of gall-bladder disease was given to her. She was treated, with some improvement. On January 30, 1937, she was awakened in the morning by abdominal pain, gas and discomfort. She took salts and water and began to vomit violently, with immediate relief.

Examination at this hospital on February, 4 1937, showed tenderness of the epigastrium and

the gall-bladder area. Laboratory studies were within normal limits, but the roentgenograms showed indefinite gall-bladder shadows in all

lesions. Resection of the involved portion of the bowel is the ideal procedure, but the location and extent of the process may



FIG. 9. Roentgenogram of Case IV, taken a few minutes after the exposure in Figure 8, showing emptying of the duodenal cap. The entire duodenum was easily visualized and the column of barium in the jejunum and diverticula appeared increased. Outlines of the diverticula are more sharply demarcated.

plates and the presence of several large diverticula in the jejunum which were partly filled with barium. (Figs. 8 and 9.)

On February 8, 1937, a cholecystectomy was performed for cholelithiasis, and exploration showed the numerous varying sized diverticula of the jejunum. The diverticula were not resected because it was felt that such an added procedure would be too much for the patient to stand. She returned to the follow-up clinic on January 7, 1938 at which time she was symptom-free and in good health.\*

*Treatment.* Guthrie and Hughes concluded that the treatment of diverticulosis of the jejunum is surgery, and that the only possible means of relieving the symptoms caused by diverticula is the removal of the

necessitate a less radical procedure. A simple excision of the diverticula or a side-tracking operation may be done.

#### SUMMARY

The literature on diverticula of the duodenum and the jejunum has been reviewed.

The difficulties in diagnosis of the diverticula are shown by the summary of the cases included here. The experiences at this clinic are similar to those of others who have dealt with this problem, as indicated by their writings.

The principal factors at work in the production of diverticula are anatomic defects of the bowel wall at the points of entrance of blood vessels and increased intra-intestinal pressures.

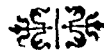
Treatment of diverticula of the small intestine is surgical, but location and extent

\* For further details in these case reports the reader is referred to the original articles by Guthrie and his associates.

of the lesions govern the type of surgery to be used in individual cases.

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# CHRONIC OBSTRUCTION AND DILATATION OF THE DUODENUM

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A SHARP distinction must be made between the conditions chronic dilatation of the duodenum and chronic obstruction of the duodenum with dilatation. This distinction is made on an etiologic and anatomic basis.

"Chronic dilatation of the duodenum is an abnormal enlargement of a whole or a part of the duodenum which may or may not be associated with duodenal retention (stasis); it may be of a primary or congenital type or of an acquired type." (Eusterman.<sup>1</sup>)

*Congenital Type.* Various writers have applied the terms megaduodenum or megaduodenum congenitum to the congenital type. The etiologic factor is assumed to be some form of neuromuscular derangement analogous to that which is supposed to underly megacolon or Hirschsprung's disease. The condition may be present with or without evidence of dysfunction. Dubose<sup>2</sup> reported such a case in an infant, and Downes<sup>3</sup> a similar case in a child four and one-half years of age. Balfour and Gray<sup>4</sup> in 1932 reported a case in which the patient was an adult 41 years of age, the condition being confirmed by roentgenologic examination and operation. Kraas<sup>5</sup> reported six cases in adults confirmed by roentgenologic examination and operation. In none of these reported cases was there evidence of mechanical obstruction.

*Acquired Type.* For academic reasons the acquired type of chronic dilatation of the duodenum may be subdivided into three varieties: The first is the functional variety, in which the duodenum is temporarily dilated due to associated disorders. Signs of dysfunction may or may not be present, and size and function are restored to normal following recovery from the

causative disorders. A second variety may be associated with duodenal ulcer, gastric lues or may follow operations. Unless dilatation is extreme cases of this type are asymptomatic. The third variety, variously designated as chronic idiopathic dilatation of the duodenum, chronic duodenal ileus, chronic duodenal stasis, or acquired chronic dilatation of the duodenum, is the most important variety of the acquired type. There is much clinical evidence to sustain the concept that chronic duodenal ileus of the acquired type is a clinical entity. Clinically, it is very difficult and at times impossible to distinguish between this type and chronic duodenal obstruction with dilatation. In fact, many investigators believe no attempt at differentiation should be made because the indications for mechanical relief are the same in both conditions irrespective of the etiologic factor.

The relation of the root of the mesentery and superior mesenteric vessels to the fourth portion of the duodenum, the variations from the normal in rotation of the colon, the general visceroptosis of the asthenic type of person and the clinical picture of "bilious attacks" with relief following vomiting of bile are suggestive factors giving rise to this condition. Halpert,<sup>6</sup> after post-mortem and anatomic studies, stated that in chronic idiopathic dilatation, obstruction of the duodenum is caused by a fold of mesentery belonging to the part of the small intestine which is displaced into the pelvis minor. He also stated that the occlusion was attributable to that type of ileus in which mechanical factors, but not factors which will cause strangulation, are present. He distinguished between this type of arteriomesenteric occlusion and the arteriomesocolic occlusion associated

with mobile ascending colon which was first demonstrated by Bloodgood.<sup>7</sup>

*Duodenal Obstruction with Dilatation.* Chronic obstruction of the duodenum with dilatation secondary to the obstruction is a clinical entity of rather frequent occurrence. The term "obstruction" is here intended to convey the idea of mechanical interference with the passage of duodenal contents. Various types of lesions act as causative factors; their relationship was investigated by Rivers and Thiessen,<sup>8</sup> who reviewed thirty-five selected cases. In twenty-six cases (74.3 per cent) obstruction occurred at the middle portion of the duodenum; in three cases (8.6 per cent), at the duodenojejunal angle. In twenty-three cases (65.7 per cent) the obstruction was due to a malignant lesion.

The causes may be divided into extrinsic and intrinsic and may be congenital or acquired. The writer has had no experience with the intrinsic congenital type, but Ladd<sup>9</sup> has reported nineteen cases. The most likely theory to account for this congenital defect is that of arrest of development of the intestine while it is in the solid stage, i.e., soon after the fifth week of fetal life. This arrest results in either atresia or stenosis. The obstruction occurs at about the level of the ampulla, at the junction of the hindgut and foregut.

Whether or not this condition is compatible with life depends entirely upon the degree of obstruction. If obstruction is complete, the average duration of life is five days; if it is incomplete and the stenosis is of such degree as not to interfere too much with the passage of duodenal contents, life may be prolonged indefinitely. Cannon and Halpert<sup>10</sup> reported a case in an 8 year old child proved by autopsy. Nagle<sup>11</sup> reported such a case in a man 72 years of age, who since childhood had suffered attacks of epigastric pain, belching, abdominal distention and vomiting. Autopsy revealed the lumen of the duodenum partially closed by a septum above the ampulla of Vater. Judd and Puestow<sup>12</sup> reported a case of duodenal obstruction in a woman 33 years

of age which they considered of congenital origin.

Of the intrinsic acquired forms of duo-

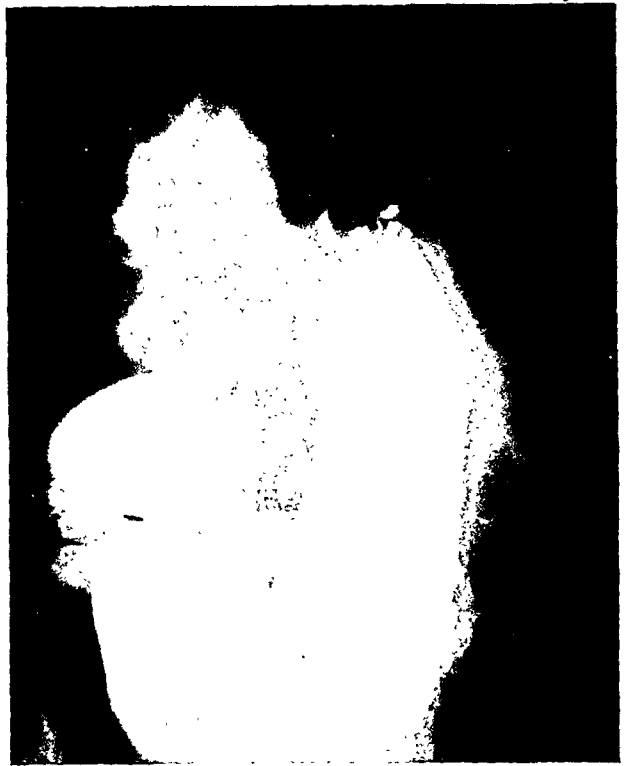


FIG. 1. Roentgenogram showing the dilated stomach and duodenum.

denal obstruction, duodenal carcinoma and carcinoma of the ampulla of Vater or of the pancreatic ducts in the duodenal wall are the most frequent causes. (Obstructions due to ulcer are not considered in connection with this subject.) Foreign bodies, such as gallstones, a hair ball (Perry and Shaw<sup>13</sup>), *Taenia saginata* (Eusterman<sup>1</sup>) and benign tumors, occasionally have been reported as causative factors.

The extrinsic causes of duodenal obstruction are much more frequent than the intrinsic causes. The relatively fixed position of the duodenum renders it particularly liable to compression from without, resulting in obstruction by neoplasms and mesenteric adenopathies. This condition is well illustrated by two cases occurring in the writer's experience during the year 1937:

**CASE I.** A negro male, 33 years of age, was admitted to the John Gaston Hospital on April 8, 1937. His chief complaint was epigastric distress thirty minutes after taking

food, relieved only by vomiting. This had been present for a period of about two years, but during the two months preceding admission,

lymph nodes ranging in size from the tip of one's finger to the distal phalanx of one's thumb. In the base of the mesentery was found



FIG. 2. Roentgenogram showing the dilated stomach, pylorus and duodenum with obstruction at duodenojejunal junction.

vomiting was of daily occurrence, the vomitus consisting of food and large quantities of yellowish watery material. Preceding vomiting there was great upper abdominal distention and visible peristalsis which was relieved by vomiting.

*Roentgenologic Examination.* Several minutes passed during fluoroscopy before gastric emptying began. No defect could be detected in the stomach, which was atonic and dilated. After emptying began, the duodenum filled; it was very large and apparently a partial obstruction was present in the second portion. There was no evidence of pathology in the stomach and pylorus. There was considerable dilatation of the first and second portions of the duodenum. However, some barium could be seen in the third portion of the duodenum and the jejunum. At six hours there was considerable retention of barium in the dilated duodenum, and at twenty-four hours there was still some barium retained in the dilated duodenum. Conclusions: partial obstruction of the duodenum with dilatation of the first and second portions and stomach. (Fig. 1.)

*Operation.* On April 26, 1937, laparotomy was done through an upper midline incision and the following gross findings were revealed: The stomach was dilated; gastro-hepatic omentum contained numerous enlarged firm

a large mass, the size of one's fist, completely obstructing the third and fourth portions of the duodenum. The first and second portions of the duodenum were dilated to twice the normal size. The jejunum was empty and contracted. Gastrojejunostomy was done after removing a node for biopsy.

*Pathologic Report.* Tuberculous lymphadenitis.

After an uneventful convalescence the patient was discharged from the hospital on May 8, 1937, completely relieved of his complaint. He was reported well on December 1, 1937.

**CASE II.** A white male, age 54 years, complained of indigestion, abdominal pain, bilious vomiting, increasing in frequency for six months. For the preceding three weeks the vomiting had occurred daily, the vomitus consisting of food and bile-stained material. There had been a loss of 50 pounds in weight. He complained bitterly of hunger and weakness. Physical examination was essentially negative.

*Roentgenologic Examination.* The stomach, pylorus and duodenum were greatly dilated, and the duodenum was obstructed at the duodenojejunal junction. A large quantity of the barium remained in the stomach and

duodenum at the end of twenty-four hours. At twenty-four hours there was barium scattered throughout the length of the small intestines, which apparently was still trickling through the obstruction at the terminal portion of the duodenum. (Fig. 2.)

The roentgenologic diagnosis was obstruction with dilatation of the duodenum at its terminal portion, probably due to carcinoma of the tail of the pancreas.

**Operation.** On January 5, 1937, laparotomy revealed the following gross findings: An enormously dilated stomach and pylorus, the latter easily admitting three fingers. The duodenum was dilated and distended to the size of a colon. At the duodenojejunal junction a hard woody mass, the size of a small orange, was found involving the tail of the pancreas. The neoplasm had also invaded the wall of the jejunum just below the ligament of Treitz. Biopsy revealed adenocarcinoma of the pancreas with colloid degeneration. Duodenojejunostomy was done.

On January 26, 1937, the patient was discharged from the hospital after a satisfactory convalescence, relieved of his vomiting and the pangs of hunger, having gained 7 pounds in weight. His death occurred six months later, but it was not due to starvation.

Post-operative adhesions may obstruct to variable degrees the upper jejunum, producing signs of duodenal obstruction and should be sought for as possible causes in all cases with histories of previous operative procedures.

Congenital anomalies, faulty rotation and bands not infrequently cause duodenal obstruction, the point of obstruction usually being at the duodenojejunal angle.

Chronic duodenal obstruction with dilatation as a clinical entity from pressure of the overlying mesenteric pedicle has been a debatable question for many years and has been discussed by many writers pro and con. Notably, Bloodgood,<sup>14,15</sup> Wilkie,<sup>16,17</sup> Halpert,<sup>6</sup> Leveuf,<sup>18</sup> Duval, Roux and Bèclère,<sup>19</sup> Balfour and Gray,<sup>4</sup> Devine,<sup>20</sup> Higgins,<sup>21</sup> Judd,<sup>12</sup> the Kelloggs,<sup>22</sup> Waugh,<sup>23</sup> Robertson,<sup>24</sup> McGehee and Anderson<sup>25</sup> and many others. It is the writer's opinion that chronic duodenal obstruction with

dilatation is a clinical entity, can be diagnosed as such and is amenable to surgical treatment with satisfactory end results.

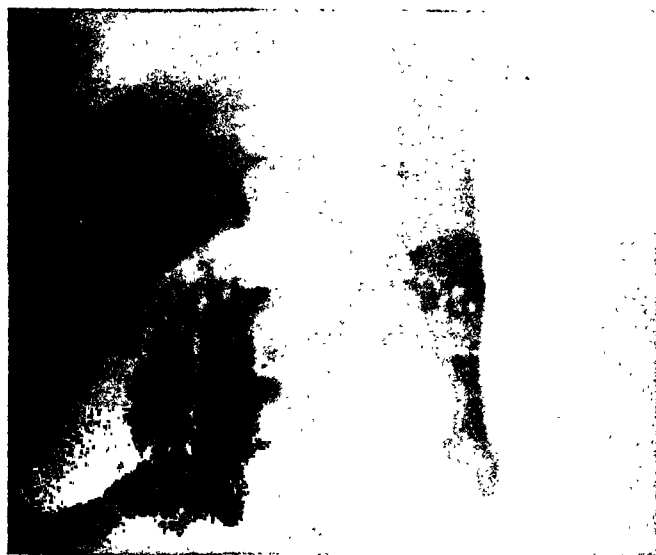


FIG. 3. Roentgenogram before operation, showing the dilated and obstructed first and second portions of the duodenum.

Imperfect rotation of the colon in fetal life, which brings the superior mesenteric vessels to lie across the duodenum, and imperfect fixation of the colon (colon mobile of Waugh<sup>23</sup>) are the ultimate etiologic factors in this condition. A case reported by the writer<sup>25</sup> illustrates and substantiates this contention:

**CASE III.** An 18 year old female who had suffered from "bilious attacks" since the sixth week of life finally presented the clinical picture of duodenal obstruction. She was of the asthenic visceroptotic type. Roentgenographic examination gave evidence of definite obstruction and dilatation of the terminal portion of the duodenum. (Figs. 3 and 4.) Exploration revealed the stomach to be dilated, the walls thin, the pylorus patulous, admitting two fingers. The duodenum was mobile, attached by a mesentery; the first, second and third portions were dilated to three times the normal size (size of one's wrist). Upon raising the transverse mesocolon, the greatly dilated duodenum was seen bulging through the transverse mesocolon. The dilatation of the duodenum extended to the point of crossing of the superior mesenteric artery, but at this same point there was considerable drag of the mesocolon, which was relieved by

lifting the mobile colon. The jejunum was empty and smaller than normal by one-half the normal circumference. *Upon pulling up the*



FIG. 4. Appearance of the stomach and duodenum at the end of six hours, showing the gastric and duodenal retention.

*mesentery the distended third portion of the duodenum was seen to empty into the jejunum filling it.* The ascending colon was mobile, attached by a mesentery. It could be lifted out of the abdominal cavity. A submesocolic duodenojejunostomy was done between the third portion and the jejunum; also a colopexy after the technique of Waugh.<sup>23</sup> Two years have passed since this operation. The patient has been well; she reports no indigestion and no bilious attacks. She considers herself completely relieved.

The diagnosis of this form of obstruction must be based on the sum total of obtainable information from the history of intermittent "bilious attacks" from infancy, positive roentgenographic findings and positive operative evidence of duodenal obstruction with dilatation of the arterio-mesenteric type. While the condition is found in the neuroviscerotonic type of

individual, it must be borne in mind that all neuroviscerotonic individuals are not also necessarily afflicted with chronic duodenal obstruction with dilatation. Where the necessary evidence (bilious attacks from infancy plus roentgenographic evidence plus operative findings) is present, the operation duodenojejunostomy first suggested by Barker and Bloodgood and first performed by Stavely<sup>26</sup> meets the operative indications and gives satisfactory end results. It is easy to perform in the suitable cases (those where the obstruction and dilatation actually exist and are demonstrable); difficulty of access and performance usually means very questionable indication and an end result disappointing to the patient and embarrassing to the surgeon. The reported poor results by certain surgeons are the results of the application of a sound surgical principle in the absence of a positive indication—a definite obstructing mechanism.

The dogmatic negation of the "superior mesenteric artery pressure" theory and the substitution therefor of the indefinite terms "eurosisn"<sup>20</sup> or "neuromuscular derangement"<sup>24</sup> are not conducive to sound thinking and are not in accord with authenticated clinical observation or clinical end results.

#### CONCLUSIONS

1. Chronic duodenal obstruction with dilatation does exist as a clinicopathologic entity.
2. Its causes are extrinsic and intrinsic, congenital and acquired, all acting mechanically.
3. It can be positively diagnosed by a careful consideration of the history, the physical examination and the roentgenologic findings.
4. The operation of duodenojejunostomy in properly selected cases fulfils the surgical indications and gives satisfactory end results.

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# THE PRACTICAL VALUE OF CHOLECYSTOGRAPHY IN SURGERY OF THE GALL-BLADDER\*

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AS an example of rare originality of thought and beautifully executed research in the field of clinical medicine, the radiologic method of examining the gall-bladder, developed by Graham and Cole,<sup>1</sup> and by them published in 1924, richly deserves the wide recognition which this contribution has received. Conceived and developed by surgeons, cholecystography was immediately embraced and employed by roentgenologists everywhere, and today the Graham-Cole test of gall-bladder function has been monopolized by Roentgen diagnosticians. In their hands it has been thoroughly tested by wide application and careful scrutiny in the light of operative and post-mortem findings, to be returned once more to surgery as an intensely practical clinical aid.

In the recent history of this clinic the frequency with which cholecystographic examination is requested has steadily increased from year to year. Compared with 2,781 such examinations in two years (April 1, 1932 to April 1, 1934), cholecystography was employed 2,103 times in the single year ending June 30, 1936. It is inconceivable that an increasing demand of this magnitude would continue to exist unless referring clinicians were convinced that results of such efforts were valuable. It is interesting to note that, at least in our experience, the net yield from comparable numbers of examinations for the two-year period in the years 1932 and 1934 and the one-year period in 1935-36 is strikingly similar. Table 1 shows the percentage distribution of results with respect to degree of visibility of the gall-bladder and the presence or

absence of stones in these two groups of examinations. Except for a slight variation in the ratio between normal visualization and non-visualization, the results are almost identical. This may be taken to indicate that the clinical staff of this institution at least makes broad practical use of cholecystography as an adjunct to other methods of gall-bladder diagnosis, requesting such examination in many patients where clinical signs are not well defined.

## CHOLECYSTITIS

The Graham test, as originally reported, was presented as a method for determining the ability of the gall-bladder to concentrate bile. Fully aware of the fact that in the case of patients whose hepatic function was seriously impaired, non-visualization of the gall-bladder might be erroneously interpreted as simple dysfunction of the gall-bladder itself, Graham and Cole extended their investigation and combined in the original method of cholecystography their colorimetric test for hepatic function, employing the radio-opaque dye used to permit visualization of the gall-bladder. The authors were quick to point out other possible sources of error in interpretation. It is insisted by several writers that faulty gall-bladder visualization, even when the technique of the test has been carefully controlled, is to be explained in some instances by reasons other than inflammatory disease of the gall-bladder itself. However this may be, it must be admitted that in general surgeons and internists request cholecystographic examination of their patients primarily for the purpose

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of confirming or disproving suspected cholecystitis.

Results of the 1932-1934 group of examinations to which reference has already been made have been analyzed in detail in a previous publication.<sup>2</sup> In that inquiry it was observed that, although only thirty-five patients in whom, the gall-bladder concentrated dye satisfactorily and in whom there was no evidence of stone, were later for one reason or another subjected to surgical proof or were seen at autopsy, frank pathologic evidence of inflammatory disease of the gall-bladder was present in 16 per cent. In brief, on the basis of that experience in this clinic, it must be expected that a normal response to the Graham test cannot be accepted as unequivocal proof that major inflammatory disease of the gall-bladder does not exist. On the other hand, perfectly normal behavior of the gall-bladder, insofar as that can be detected by x-ray methods, does offer us assurance eighty-four times out of one hundred that the patient under examination, whatever the cause for his symptoms, does not have clinically significant cholecystitis. (Fig. 1.)

As the result of the same survey it was learned that complete non-visualization of the gall-bladder after carefully controlled preparation was associated with demonstrable cholecystitis of major extent in 80 per cent of the patients later subjected to proof. (Fig. 2.) Here again an apparently inescapable factor of error was encountered which must be taken into consideration in the analysis of any one individual patient's status. We found that twenty times in one hundred it was necessary to ascribe the gall-bladder's failure to concentrate dye to some cause other than cholecystitis.

Although it is seldom necessary for the roentgenologist, when interpreting cholecystographic results, to straddle the important question as to whether or not the gall-bladder has demonstrated its ability to concentrate bile in a normal fashion, there are undoubtedly instances when he

must qualify his report to the extent of saying that the gall-bladder shadow is unusually faint. Since this observation necessarily involves the exercise of individual judgment, it follows that in this group accuracy of prediction in regard to the presence or absence of cholecystitis will vary considerably in different hands. It is apparent that in our clinic "faint visualization" spells to a certain degree indecision, for in this group we know that we can only expect subsequent pathologic proof of significant gall-bladder disease in 61 per cent of patients so classified.

Many roentgenologists still rely to a considerable extent upon the behavior of the gall-bladder in response to fat feeding after concentration has occurred in order to arrive at an opinion regarding gall-bladder status. In this clinic we have gradually abandoned this feature of cholecystographic examination primarily in order to save time. To date we have not felt that accuracy of prediction has suffered by the omission of this step.

#### CHOLELITHIASIS

Certainly it is well recognized that the demonstration of the existence of gall-stones is not per se an imperative reason for surgical treatment. Roentgenologic examination of the gall-bladder is not conducted for the purpose of accumulating surgical material, but this in no wise lessens the value of accurate information so obtained regarding the presence, the character, and the behavior of biliary calculi. We are concerned here with the practicability of such x-ray methods in reliably assisting the surgeon to arrive at his decision regarding the advisability of gall-bladder surgery, and in that connection cholecystography is a tremendously important procedure.

The Graham test designed primarily to determine gall-bladder function is tremendously helpful in the diagnosis of cholelithiasis. Before the days of cholecystography only those stones containing



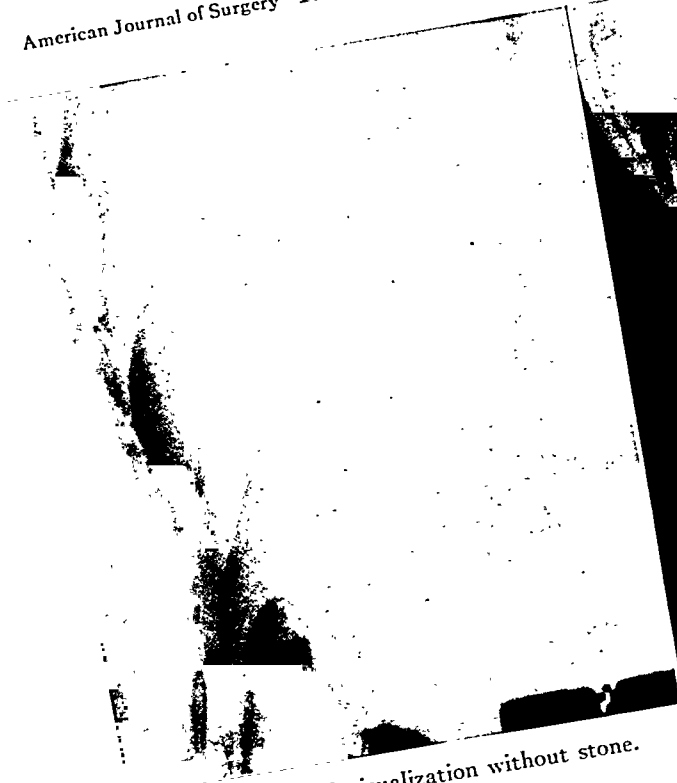


FIG. 1. Normal visualization without stone.

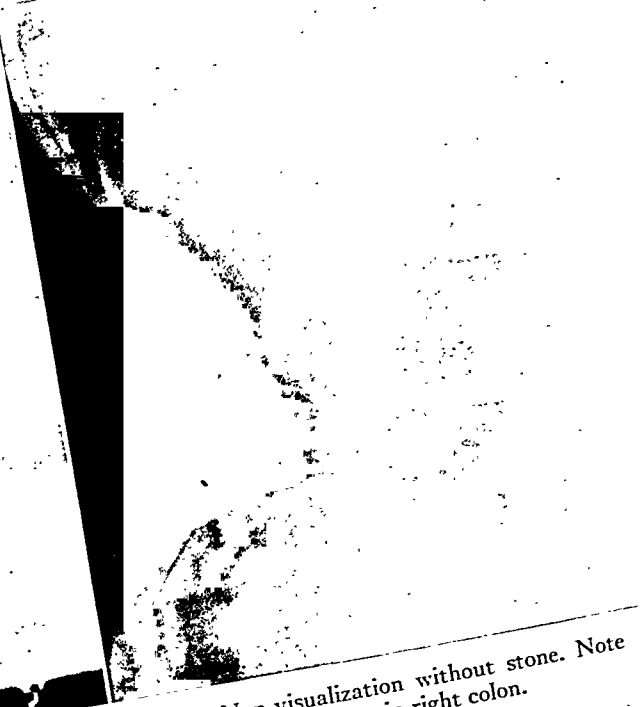


FIG. 2. Non-visualization without stone. Note excess dye in right colon.



FIG. 3. Normal visualization with multiple, large, faceted stones.



FIG. 4. Faint visualization with numerous minute opaque stones. Enlarged liver. Gall-bladder displaced downward close to hepatic flexure of colon.

FIG. 5.



FIG. 6.

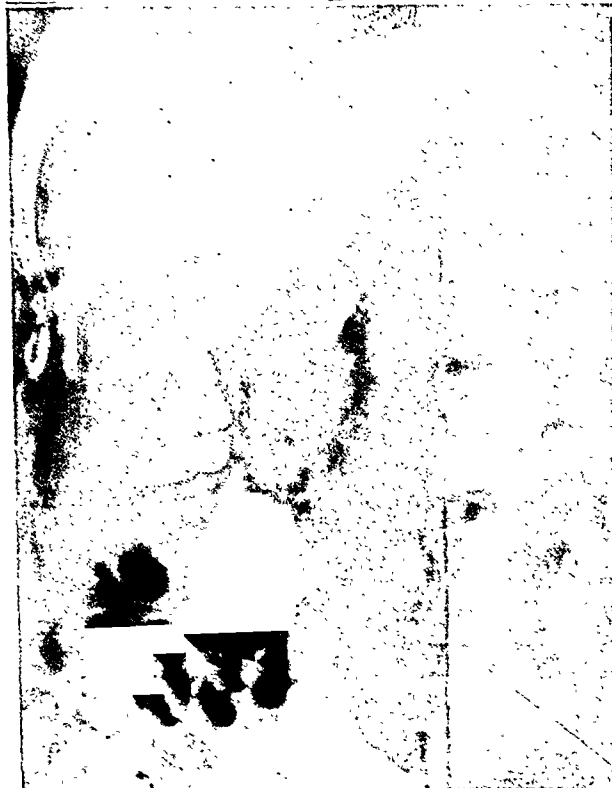


FIG. 7.



FIG. 8.

FIG. 5. Faint visualization. Five semiopaque stones in gall-bladder, six in common duct.

FIG. 6. Same as Figure 5 thirty minutes after fat-feeding. Note rearrangement of stones in gall-bladder and downward displacement of lowermost common duct stone.

FIG. 7. Same as Figures 5 and 6, eight days later following spontaneous passage of duct stones. Note clustering of gall-bladder stones. No dye administered on this occasion.

FIG. 8. Normal visualization without stone. One large and several small renal calculi.

a fair percentage of lime salt could be recognized roentgenologically for the very simple reason that cholesterol stones, being virtually of the same density as surrounding soft tissues, cast no differential shadow upon the film. The roentgenologist who could demonstrate calculi before operation in one-third of the cases where stones were later removed by the surgeon was considered an artist in his field. We have found that we can do as well without developing gall-bladder specialists within the department of roentgenology, for today considerably improved photographic materials and x-ray apparatus virtually assure us that all gallstones containing even a small amount of lime salt can be recognized easily. Even in cases subjected to cholecystography where the concentrating power of the gall-bladder is entirely lost, we can still recognize cholelithiasis in 32 per cent of the patients in whose cases this diagnosis is later proved. (Fig. 7.)

We know that if the gall-bladder's concentrating power has not been entirely destroyed, if the gall-bladder can be even faintly visualized after dye administration, that our accuracy in the matter of recognizing biliary calculi jumps to the surprising figure of 94 per cent. This is possible because we are now able to see not only calculi which contain lime salt, but in addition even stones composed of pure cholesterol which are rendered visible by virtue of the artificial contrast media in the gall-bladder. (Fig. 3.) This should be, and as a matter of fact is, of the utmost practical importance in gall-bladder surgery.

If it were possible in all cases to increase the density of bile contained in the gall-bladder sufficiently to provide this necessary degree of contrast, the surgeon would never need be in doubt before operation as to the accuracy of his clinical diagnosis of stone. Unfortunately perhaps, cholelithiasis and major grades of cholecystitis may and do coexist in a good many instances. Under these circumstances cholesterol stones, well known to

be in the majority, are as obscure to the searching eyes of the roentgenologist as they were before cholecystography was introduced. In the case material previously reported, stones were ultimately observed at operation or at autopsy in 121 patients. Roentgenology reported the correct state of affairs before operation in fifty-nine of these patients with an efficiency of 49 per cent. The 94 per cent accuracy obtained in those cases where bile concentrating power had not been completely lost, suffered notably by the inclusion of a considerable number of patients in whom major cholecystitis was associated with cholesterol biliary calculi. Table II shows the effect of gall-bladder visibility upon the accuracy of stone recognition.

TABLE I

2781 Examinations 1932-34 (Two Years)		2103 Examinations 1935-36 (One Year)
61 per cent	Normal visualization	69 per cent
29 per cent	Non-visualization	21 per cent
10 per cent	Faint visualization	10 per cent
9.2 per cent	Stones (all cases)	9.1 per cent

TABLE II  
PROVED CASES OF CHOLELITHIASIS

No. of Cases		Pre-operative x-ray Diagnosis of Stone	
88	No dye shadow	28	32 per cent
121	All cases	59	49 per cent
33	Visible dye shadow	31	94 per cent

The development of radiologic technique to the point of excellence necessary for the greatest clinical exploitation of cholecystography has been accomplished as the result of widespread renewal of interest in this field of radiologic diagnosis which has come following the introduction of Graham's method. The manufacturers of x-ray equipment, intensifying screens, and photographic films have responded nobly

to the demands for increased excellence relayed to them by the roentgenologist. On his part the roentgenologist has learned to scrutinize gall-bladder roentgenograms with great care, and as a result, often finds himself recognizing gallstones which, without the invaluable assistance of localization provided by gall-bladder visualization, might well have escaped his notice because of unusual position, even though the stones themselves may be of sufficient density to cast a shadow. Figure 4 offers a striking example of this situation. The several very minute stones found to lie close to the iliac crest in this case can be identified as biliary calculi beyond question of a doubt because of the faint gall-bladder outline cast by its dye-laden bile. Cholecystography is helpful not only in recognizing biliary stones when they exist, but also, on occasion, in proving that shadows suspected of representing gallstones, in reality lie outside the gall-bladder lumen. Figure 8 shows how cholecystography was successfully used in one instance to identify unusual calculi in the right kidney.

Utilization of the fat meal to produce gall-bladder shrinkage has a practical application which at times serves the roentgenologist to very good advantage. Even though the bile contained within the gall-bladder may contain insufficient iodized phenolphthalein to make its presence known radiographically, rearrangement of contained stones, visible in their own right, following the administration of fat may be so characteristic as to provide accurate differentiation between those which lie within the gall-bladder itself and those which may lie in the biliary ducts. Figures 5 and 6 illustrate this utilization of cholecystography. In Figure

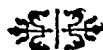
5, five semi-opaque stones are seen within the gall-bladder, while six, lying somewhat nearer to the spine in single file, are presumably in the common duct. Figure 6 shows rearrangement of the gall-bladder stones one-half hour after fat feeding and shows the lowermost stone in the common duct now displaced sharply downward, presumably carried along toward the ampulla of Vater. Figure 7 represents the situation shortly after the spontaneous passage of the common duct stones and serves to show, incidentally, that opaque stones can be recognized equally well with or without dye concentration.

#### SUMMARY

Since its introduction by Graham and Cole in 1924, cholecystography, which is now very widely used throughout this country and abroad, has brought to the surgeon interested in the diseases of the gall-bladder a very practical and reliable means of pre-operative diagnosis. Not only is cholecystography valuable in gauging gall-bladder function, but also in determining the presence or absence, the character and number, the location and the behavior of gallstones. The method is also of practical importance in differentiating gallstones from other calculi in the right abdomen which might otherwise be misinterpreted.

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# COMBINED CHOLECYSTOGRAPHY AND LIVER FUNCTION DETERMINATION FOLLOWING THE INTRAVENOUS ADMINISTRATION OF ISO-IODEIKON\*

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THE clinical study reported in this paper was prompted by several considerations, the most important of which was a desire to know more about liver function in the patient being prepared for biliary tract surgery.

Oral cholecystography has been the method of choice at the University Hospital in the past. It has been felt that the accuracy in diagnosis was reasonably high; reactions were infrequent and the time required for the oral test in preparation and administration of dye was low. No large series of intravenous cholecystograms has been made in this hospital, partly because of a fear of dye reaction in the intravenous method and largely because the oral method of administration has proved satisfactory.

Graham<sup>3</sup> has remained one of the warmest advocates of the intravenous method of administration and has published many reports in reference to its merits. He has preferred the use of sodium-phenoltetraiodophthalein to sodium-tetraiodophenolphthalein<sup>1,2</sup> because of its ability to stain the blood serum. This ability of sodium-phenoltetraiodophthalein, commercially called iso-iodaikon, to stain the blood serum, is the basis for one of the liver function tests used by Graham. He has reported<sup>3</sup> a striking reduction in the morbidity and mortality of a group of biliary tract cases in which operation was delayed until the liver function, as indicated by the above mentioned method, had returned toward what was considered normal.

We have used the method of combined intravenous cholecystography and liver function determination on a group of

seventy patients. The method of dye preparation and administration was essentially that advocated by Graham. The dye, iso-iodaikon was procured in powder form, the solution was prepared for each individual case not longer than eighteen hours prior to administration and the maximum dose was 2.5 Gm. regardless of the fact that many of the patients weighed more than 63 Kg. In all cases the 5 per cent solution was diluted with 200 c.c. of saline during the intravenous injection by the gravity method. A 20 c.c. specimen of blood was drawn from the other untraumatized arm exactly thirty minutes after the middle of the injection time period. This specimen was later used for the colorimetric determination of the dye retention.

The dye was given to eighty-four patients. Fourteen of these had no x-rays made for financial reasons and the series of seventy cases to be reported includes only those having simultaneous cholecystography and liver function determination. Twenty of the cases are considered normals; the remaining fifty cases, thirty-six of which were operated upon, were taken routinely from the incoming patients. The test was done as soon after admission as the author's time would permit. The series included many extremely ill patients and the test was run irrespective of fever or intense jaundice.

In 6 per cent of the total series of cases, there were reactions from the dye severe enough to warrant more than passing consideration. Two cases of thrombophlebitis lasted for six days each, but neither ended in suppuration. One case of cellulitis occurred after 40 c.c. of the dye solution

\* From the Department of Surgery, University of Michigan.

was given outside the vein. One rather severe systemic reaction developed in a debilitated woman of 45 who had been jaundiced continuously for eleven months.

*Retention Figures.* The following seventy cases are subdivided into groups, according to roentgenologic, clinical and operative findings.

#### A. Non-operative:

1. Normal gall-bladder visualization without stone.

Number of cases..... 20  
Average retention of dye.... 12 per cent  
Highest retention of dye.... 20 per cent  
Lowest retention of dye..... 0 per cent

2. Abnormal gall-bladder visualization in which operation was delayed for financial reasons.

Number of cases..... 4  
Average retention of dye.... 24 per cent  
Highest retention of dye.... 40 per cent  
Lowest retention of dye..... 10 per cent

3. Biliary cirrhosis (clinical diagnosis in three cases; autopsy findings in one case).

Number of cases..... 4  
Average retention of dye.... 26 per cent  
Highest retention of dye.... 45 per cent  
Lowest retention of dye..... 10 per cent

4. Miscellaneous group of cases in which jaundice was present.

- (1) Clinical diagnosis: Common duct stone. 10 per cent dye retention. Bilirubin 30. Discharged to return for operation.
- (2) Clinical diagnosis: Carcinoma of pancreas. 70 per cent dye retention. Bilirubin 110. Discharged without operation on family decision.
- (3) Clinical diagnosis: Carcinoma of gall-bladder with liver metastases. 70 per cent dye retention. Bilirubin 300. Death occurred, no autopsy.
- (4) Clinical diagnosis: Subsiding acute cholecystitis. 5 per

cent dye retention. Bilirubin 55. Operation temporarily postponed.

- (5) Clinical diagnosis: Deferred. 60 per cent dye retention. Bilirubin 60. Death occurred. Autopsy showed post-operative stricture hepatic ducts.

- (6) Clinical diagnosis: Carcinoma of pancreas. 40 per cent dye retention. Bilirubin 40. Discharged because of ascites and marked anemia.

#### B. Operated cases:

1. Cirrhosis

Number of cases..... 3  
Average retention of dye.... 10 per cent

2. Gallstones without jaundice

Number of cases..... 11  
Average retention of dye.... 15 per cent  
Highest retention of dye.... 30 per cent  
Lowest retention of dye..... 5 per cent

3. Gallstones with jaundice. Common duct explored and found to contain no stones.

Number of cases..... 2  
Average retention of dye.... 27 per cent

4. Common duct stone without jaundice.

Number of cases..... 3  
Average retention of dye.... 21 per cent

5. Jaundice due to common duct stone, post-operative stricture or diffuse common duct fibrosis.

Number of cases..... 7  
Average retention of dye.... 23 per cent  
Highest retention of dye.... 40 per cent  
Lowest retention of dye..... 10 per cent

6. Jaundice due to carcinoma of pancreas, duct system or liver.

Number of cases..... 10  
Average retention of dye.... 27 per cent  
Highest retention of dye.... 60 per cent  
Lowest retention of dye..... 10 per cent

In the group of thirty-six operative cases there were five deaths, four of which

occurred in patients with advanced carcinoma of the biliary tract. Post-operatively three of the group developed bronchopneumonia. The non-jaundiced patients averaged six days in the hospital prior to operation; the jaundiced patients fifteen days. The mean number of days in the hospital prior to the dye test was four.

We wish to stress one finding which will be discussed more in detail at a later time: ten patients had bilirubin determinations between 100 and 200 mg. per 1000 c.c., the average of which was 155. The average dye retention in these ten patients was 36 per cent, which was higher than any of the average retention levels grouped above according to operative findings. It should be noted, however, that the dye retention did not consistently vary with the bilirubin level. This fact is shown by retentions of 15 per cent, 15 per cent, 10 per cent, 10 per cent occurring in patients where the bilirubin determinations were respectively 185, 100, 110 and 160 mg. per 1000 c.c.

*X-Ray Findings.* One-third of the group of seventy cases was given the dye first by mouth and later by vein. An opportunity is afforded in this group to compare the roentgenologic findings. The x-ray findings in three patients following the oral dye were "non-visualization without stones." After intravenous dye in the same patients, the findings were "normal visualization with stones." The three were operated and stone-containing gall-bladders removed. It should be noted that the comparison is not entirely fair, as the oral dye was vomited in one instance. Following oral dye administration in three other cases, the x-rays were read as "non-visualization without stone" in two and "faint visualization without stone" in the third. After intravenous dye in the same three patients, the findings were "normal visualization without stone." The oral dye was vomited in one of these cases. It should be realized that a repeat of the x-ray studies after a second administration of oral dye might have likewise revealed contradictory findings. Strictly speaking, however, stones

later removed at operation were missed three times following oral dye and in the second three cases operation would have in all likelihood revealed normal gall-bladders.

In the group of patients presenting clinical jaundice, no case of gall-bladder visualization occurred, regardless of the mode of dye administration. This fact will be discussed in a later paragraph.

*Discussion.* Graham considers the above discussed test of liver function to be of great value for two reasons: (1) He considers a retention of 50 per cent or more in the thirty minute specimen to indicate a poor operative risk. In such cases he advises delay of operation until the function has improved and during the wait advises glucose and calcium administration in addition to transfusion if indicated. He has concluded that poor results following cholecystectomy are commonly due to serious liver damage. (2) The amount of retention is of aid in differential diagnosis since the retention found in jaundice due to carcinoma of the biliary tract is uniformly lower than the retention caused by common duct stones. This is explained by the assumption that biliary tract malignancy is not commonly accompanied by a marked degree of hepatitis.

It is obvious that the clinical use of the test depends on high retention figures, indicating liver damage and delayed operation. In our series of cases no group retention figure was found consistently high enough to warrant delay in operation merely because of the retention. Likewise, essentially the same retention figures were obtained in the cases of common duct stone and biliary tract carcinoma. The table on page 155 gives a rough estimate of the retention in our group compared to Dr. Graham's. In comparison, we have used only the proved diagnoses from operation and those cases in which the clinical diagnosis was reasonably obvious.

It is thus seen from our results:

1. In no group of cases was the retention high enough to warrant a delay in operation. A retention exceeding 50 per cent was

found in only four cases. Two of these patients were obviously in the terminal stage of biliary tract carcinoma and operation was not advised. A third case with marked jaundice came to operation six days after admission to the hospital. Operation was being delayed because of the retention when evidence of marked infection occurred and a laparotomy was done as an emergency procedure. An empyema of the gall-bladder was found. The fourth patient with a retention of over 50 per cent was being prepared for operation. Suddenly bleeding from the nose, stomach and into several joints occurred and in spite of many transfusions death resulted. Autopsy revealed an extensive post-operative hepatic duct stricture and marked liver damage.

	Graham, Per Cent	University Hospital, Per Cent
Normal retention.....	10	10
Cholecystitis without jaundice.....	26	20
Cholecystitis with jaundice.....	53	25
Carcinoma of pancreas, duct system and liver.....	22	27
Cirrhosis.....	45	18
Diabetes mellitus.....	18	15

2. Comparing the group of common duct stone and that of carcinoma, we find essentially the same retention with slightly higher figures in the carcinoma cases.

We are at a loss to explain why our retention figures do not parallel or approximate those of Dr. Graham in the groups classified above. There are few reports in the literature giving the actual retention values in any series of cases. Cutler<sup>4</sup> used iso-iodoikon in a group of seventy-five cases. The average retention of his listed cases was below 20 per cent and only one retention above 40 per cent was found. He selected cases, for the most part, in which the gall-bladder disease was of long standing. The dye was not given to jaundiced patients. Cutler was unable to demonstrate any constant relation between the dye

retention and the post-operative course. Waters and King<sup>5</sup> reported forty cases in which the highest retention following intravenous iso-iodoikon was 40 per cent.

The value of dye excretion as a test of liver function has been much debated. It is obvious that any dye substance must be excreted by the liver if that dye is to be used as a test of liver function. A large amount of work on the mode of absorption and excretion of phenolphthalein derivatives has been done by Abel,<sup>6</sup> Rowntree and others. With the exception of the work of Behrend and Heesch<sup>7</sup> and that of Maddock and Whitaker<sup>8</sup> the derivatives studied did not include iodoikon or its chemical isomer, iso-iodoikon. A. J. Delario<sup>9</sup> has studied tetraiodophenolphthalein and finds that it is absorbed by mouth and rectum and is eliminated by the bile, urine and feces. He finds that under normal conditions in dogs the liver excretes 60 to 70 per cent of the dye, the kidneys, 5 to 10 per cent, and the large bowel 25 per cent. He has shown that the portion excreted through the large bowel is by direct primary excretion. He believes that in cases of common duct obstruction the mode of excretion is primarily through the large bowel and kidney. Maddock and Whitaker, working with sodium-tetraiodophenolphthalein administration in animals, concluded that in complete biliary obstruction the dye was excreted by the bowel and kidneys. Their laboratory study was prompted by the well known fact that in complete biliary obstruction gall-bladder visualization does not occur after dye administration.

Considering the above experimental evidence and the known failure of gall-bladder visualization in complete biliary obstruction, it seems reasonable to believe that the retention of phenoltetraiodophthalein may not be a satisfactory test of liver function. Four of our cases, who clinically had complete common duct obstruction and a bilirubin average of 140 mg., gave dye retentions averaging 12 per cent. The dye in these cases may well have been



excreted largely by the bowel and kidney. Two of these cases had carcinoma of the pancreas at operation and extensive metastases to the liver; in the third a marked cirrhosis was found, and in the fourth an extensive post-operative common duct stricture was encountered. It is hard to believe that the liver function was normal in these four cases.

#### CONCLUSIONS

1. The intravenous method of gallbladder dye administration is a safe procedure for all classes of suspected biliary tract pathology; reactions are few and factors of doubt present in the oral method are eliminated.

2. The value of blood stream retention of phenoltetraiodophthalein as a test of

liver function and thus of operative prognosis is debatable.

3. Phenoltetraiodophthalein retention figures are of no value in the differential diagnosis of obstructive jaundice.

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IT [electrodesiccation] is unsuitable for the treatment of large masses of tissue or those that extend more than about 1 cm. below the surface.  
From—"Diathermy" by Elkin P. Cumberbatch (William Wood).

# CONSIDERATION OF FAINT GALL-BLADDER SHADOWS IN INTRAVENOUS CHOLECYSTOGRAPHY\*

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THE universal acceptance of cholecystography has unquestionably established its usefulness as the most reliable single method in the diagnosis of gall-bladder disease. At the present time one rarely questions the fact that the function of the gall-bladder is seriously impaired when it cannot be visualized on the Roentgen film following the intravenous administration of phenoltetraiodophthalein sodium. Based on such a report the number of errors is negligible.<sup>1</sup> At this clinic an effort has been made from the inception of cholecystography by Graham and Cole<sup>2</sup> to make a radiologic diagnosis of pathologic gall-bladder when the shadow lacked density or was "faint." The object of this paper is to determine the reliability of such a diagnosis and to estimate its practicability for clinical use. We consider that this diagnosis is justifiable only following the intravenous administration of the dye,<sup>3</sup> and its success depends on the following conditions and factors:

1. The normal gall-bladder mucosa concentrates the bile and the phenoltetraiodophthalein, thereby permitting the visualization of the gall-bladder.

2. In early gall-bladder disease the mucosa may be damaged in a manner to hinder the concentration of the bile, and hence the dye is not sufficiently concentrated. Thus the gall-bladder shadow in the cholecystogram appears less dense—fainter on the Roentgen film—than that produced by a normal organ. It is the gall-bladder with an impaired function rather than one with a complete loss of function that is recognized by this method.

3. The success of a diagnosis based on the degree of impaired function, we think, demands that a constant and known quantity of phenoltetraiodophthalein reaches the blood stream. This can only be achieved by the intravenous method. Otherwise it is impossible to compare the density of one gall-bladder shadow with another. We have no confidence in the radiologic diagnosis of pathologic gall-bladder because of faintness of shadow when obtained by oral cholecystography, because the amount and rate of absorption of the dye from the alimentary canal is unknown. Furthermore, the intensified oral method advocated by Stewart and Illick<sup>4</sup> permits the patients to receive varying amounts of the chemical, a factor which, to us, complicates the accurate comparison of gall-bladder shadows.

4. The cholecystograms must be technically perfect, of uniform quality, and without movement. This requires careful positioning and control of the patient during the examination. The radiographic equipment must be capable of allowing a very short exposure.

The material for this report consists of a study of the clinical diagnosis, the symptomatology, operative findings and pathologic reports of all patients in whom the gall-bladder shadow was sufficiently faint to justify a diagnosis of a pathologic gall-bladder, in the five years from January 1, 1933 to January 1, 1938. In this period a total of 176 patients were so diagnosed and constitute the number used in this survey.

The total number of patients tested intravenously for the same span was 1,355. Thus only once in every 7.7 patients, or

\* From the Edward Mallinckrodt Institute of Radiology, Washington University School of Medicine, St. Louis.

12.9 per cent, is a gall-bladder diagnosed as pathologic because of a faint shadow.

*Sex, Race, and Age Distribution.* In Chart I is shown the distribution of these

*Symptomatology.* The review of the hospital (151) and out-patient histories (25) revealed that the chief symptoms complained of by these patients could be

CHART I  
SEX, RACE AND AGE DISTRIBUTION

Total Cases	Sex		Race		Age Groups				
	Female	Male	White	Colored	Below 30	30-40	40-50	50-60	Above 60
176	127 72.2 per cent	49 27.8 per cent	165 93.7 per cent	11 6.3 per cent	27 15.3 per cent	29 16.4 per cent	54 30.7 per cent	36 20.5 per cent	30 17.0 per cent

The figures in this and the following charts constitute a five-year survey (January 1, 1933 to January 1, 1938) of all patients who received, because of the faintness of the shadow, a radiologic diagnosis of pathologic gall-bladder. All patients were given the phenoltetraiodophthalein sodium by the intravenous method.

patients as regards sex, race, and age groups. As would be anticipated, the females predominated and made up about 72.2 per cent of the group. Likewise, it is seen that the whites formed the great majority, being some 93.7 per cent. It is interesting to speculate whether the Caucasian race is more sensitive or responsive to symptoms of right upper quadrant

classified into four groups. (Chart II.) All cases possessed at least one or more of the four symptoms as a chief complaint and were so recorded by the clinician in charge.

It is surprising that right upper quadrant or epigastric pain was present in 64.7 per cent of all cases. No attempt was made to grade or classify the pain, but it was incorporated in the statistics only when described as a major symptom.

The term, "gastric distress" includes epigastric fulness, "bloating," flatulence, burning and eructation, related or unrelated to meals or fatty foods. Less than half (45.4 per cent) complained of these symptoms, which Rehfuß and Nelson<sup>5</sup> cite as the most common in chronic cholecystitis. When combined with the number having nausea with or without vomiting (31.8 per cent), the total percentage becomes 77.2 per cent. Since but few suffered from severe vomiting, it is felt that uniting the two groups produces a truer idea of the number afflicted with symptoms of upper abdominal distress.

Jaundice was present in 11.9 per cent as noted by the physician at the time he recorded the physical examination. Patients stating that they had had jaundice prior to examination were excluded. This may explain our low percentage when

CHART II  
SYMPTOMATOLOGY

Total Cases	Pain in R. U. Q. or Epigastrium	Gastric Distress (Flatulence, Fulness, Burning, etc.)	Nausea with or without Vomiting	Jaundice Present
176	114 64.7 per cent	80 45.4 per cent	56 31.8 per cent	21 11.9 per cent

disease or if the occurrence of gall-bladder disorders in the white race is an indication of the differences in social and economic levels.

The age distribution is that which usually obtains in patients with gall-bladder disease. Over one-half (51.2 per cent) were in their fifth and sixth decades.

compared with other studies. Hartman<sup>6</sup> in a series of 375 operated patients with cholecystitis without stone reported jaundice in 16 per cent.

the preceding; and in the third, those which some observers might question as being normal. (Chart III.) The number and percentage of total errors in the radiologic

CHART III  
COMPARISON OF RADIOLOGIC WITH CLINICAL DIAGNOSIS

Total Cases	Radiologic Diagnosis*			Clinical Diagnoses					Radiological Diagnosis Not Confirmed by Clinical Diagnosis
	Very Faint	Faint	Moderately Faint	Principal Diagnosis of Cholecystitis			Principal Diagnosis Other than Cholecystitis	Secondary Diagnosis of Cholecystitis	
				Acute	Chronic	Acute and Chronic Cholecystitis Plus Stones†			
176	41	102	33	7	106	37	63	42	21 5 eliminated because of — extensive liver disease‡ 16
	23.3 per cent	57.9 per cent	18.7 per cent	4 per cent	60.2 per cent	21.0 per cent	35.8 per cent	23.8 per cent	11.9 per cent (unselected) 9.1 per cent (selected)

\* In a total of 11 (6.2 per cent) of the cases, the diagnosis was reported as (?) stones.

† These patients were also recorded as acute or chronic cholecystitis in columns to immediate left.

‡ 1 Toxic hepatitis from arsenic.

1 Hepatitis and catarrhal jaundice.

1 Extensive carcinoma of stomach with metastases to liver, jaundice.

2 Extreme jaundice, etiology undetermined.

*Radiologic and Clinical Diagnoses.* The radiologic diagnosis of "pathologic gall-bladder due to the faintness of its shadow" is difficult. Nor is it easy to describe the appearance of such a shadow. The accuracy of the diagnosis hinges largely on the ability and experience of the roentgenologist, and the personal equation comes into play. It is a diagnosis that should not be made unless the physician is familiar with the changes in density resulting from improper Roentgen exposure and from variations in the thickness of the patients.

All the cholecystograms were reviewed and divided into three groups depending on the relative faintness of the shadow. In the first are the extremely faint, almost invisible shadows; in the second, those in which the shadow is slightly denser than

when compared with the clinical diagnosis is small, being 11.9 per cent unselected, and 9.1 per cent selected. Of these errors, two belong in the very faint group, seven in the moderately faint group, and twelve in the faint group.

In the total series, 4 per cent had a clinical diagnosis of acute cholecystitis, while the great majority, 60.2 per cent, had a diagnosis of chronic cholecystitis. Of these, 21 per cent received an additional diagnosis of questionable stones. In 23.8 per cent the diagnosis of cholecystitis was secondary to a principal diagnosis of other diseases. There was a great variety of these diseases, although obesity, hypertension, appendicitis, duodenal ulcer, hypothyroidism and arteriosclerosis appear more frequently than any others.

**Operative and Pathologic Findings.** The value of an accurate diagnosis of cholecystitis predicated on "faint gall-bladder shadow" is at once apparent when it is seen

sufficiently damaged to produce symptoms of such intensity that 47.6 per cent were deemed suitable for surgical treatment. These facts alone should establish the

## CHART IV

## COMPARISON OF RADIOLOGIC DIAGNOSIS WITH OPERATIVE AND PATHOLOGIC REPORTS

Total Cases	Operation		Operative Findings			Operation Advised but Refused or Contra-indicated	Autopsy Reports Cholecystitis	Radiologic Diagnosis Not Confirmed by Operation or Autopsy
	Cholecystectomy	Exploratory Laparotomy	Microscopic Diagnosis of Cholecystitis	Cholecystitis Plus Cholelithiasis	Gall-bladder Grossly Normal			
176	43 24.4 per cent	17 9.6 per cent	21 11.9 per cent	26* 15 per cent	13 7.3 per cent	24 13.6 per cent	2 1.1 per cent	13 7.3 per cent

\* Eleven were cholesterol stones, usually small. The composition of the others was not stated. Cholelithiasis here includes "sand" and "gravel."

that 34 per cent of these patients were submitted to surgery and that one in every four (24.4 per cent) had a cholecystectomy! An additional 13.6 per cent were advised to have a cholecystectomy, but either operation was refused or operation was contraindicated because of the physical condition of the patient. In other words, nearly one-half the patients (47.6 per cent) who were diagnosed as having a "pathologic gall-bladder because of a faint shadow," had symptoms of sufficient severity to warrant a recommendation for surgery.

The gall-bladders removed at operation were examined grossly and microscopically for a pathologic diagnosis. Some 11.9 per cent were classified as chronic cholecystitis and 15 per cent as cholecystitis plus cholelithiasis. This 15 per cent with cholecystitis and cholelithiasis found after pathologic examination, is less than the number (21 per cent) diagnosed clinically. However, in only 6.2 per cent was the question of stones considered in the radiological report. This point emphasizes the fact that the stones were too small or insufficient in number to cause a recognizable shadow. Again it is apparent that the diseased gall-bladders in this study had only impaired function, but yet were

value and practical use of the radiologic diagnosis of "pathologic gallbladder because of the faintness of the gall-bladder shadow."

The error of radiologic diagnosis as compared to the operative and pathologic findings was 7.3 per cent, or an accuracy of 92.7 per cent. The question arises as to the cause of these errors and what can be done to eliminate them. Ten errors occurred in the faint group and three in the moderately faint group. Thus the majority of errors are in the faint and moderately faint groups, and in the future, a little more leeway should be given the films in these groups; that is, whenever possible, films that are only moderately faint should be considered as normal. It should be borne in mind that a radiologic diagnosis of pathologic gall-bladder is not, in itself, an indication for cholecystectomy. Graham, Cole, Copher and Moore<sup>7</sup> repeatedly state that cholecystography is a test of the functional capacity of the gall-bladder.

## SUMMARY

1. A survey was made of all patients receiving a radiologic diagnosis of "pathologic gall-bladder because of the faintness of the shadow" over a five-year period

(January 1, 1933 to January 1, 1938). A total of 1,355 patients received intravenous cholecystography. The gallbladder was diagnosed as pathologic because of a "faint shadow" in 12.9 per cent of the patients (176), which constitutes the number used in this survey.

2. Some 72.2 per cent of the total group were females; 93.7 per cent were white; and 51.2 per cent were between 40 and 60 years of age.

3. The symptoms complained of by these patients were those accepted for the most part as characteristic of chronic cholecystitis: (right upper quadrant or epigastric pain (64.7 per cent); upper abdominal distress (77.2 per cent); coexisting jaundice (11.9 per cent).

4. The radiologic diagnosis of pathologic gall-bladder based on the faintness of the shadow, when compared with the clinical diagnosis, showed an accuracy of 88.1 per cent in unselected cases, and 90.9 per cent in selected cases. A clinical diagnosis of chronic cholecystitis was present in 60.2 per cent; cholecystitis and cholelithiasis in 21 per cent; and acute cholecystitis in 4 per cent. A total of 34 per cent of these patients were submitted to surgery, and 24.4 per cent, or one in every four, had a cholecystectomy. An additional 13.6 per cent were advised to have surgery but either they refused, or the operation was contraindicated by the patient's poor physical condition.

5. The gall-bladders, when examined pathologically both grossly and microscopically, showed that 11.9 per cent had chronic cholecystitis; 15 per cent cholecystitis and cholelithiasis. A clinical diagnosis of cholelithiasis was made in 21 per cent, but in the radiologic diagnosis in

only 6.2 per cent. A comparison of the operative findings and pathologic reports with the radiologic diagnosis of "pathologic gall-bladder because of faintness of the shadow" revealed an accuracy of 92.7 per cent.

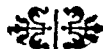
#### CONCLUSIONS

In view of the facts contained in the above summary, we feel that in intravenous cholecystography a "faint" gall-bladder shadow warrants a radiologic diagnosis of "pathologic gall-bladder." Such a diagnosis is practical and of clinical value. Furthermore, the accurate diagnosis of pathologic gall-bladders shown by "faint" shadows supplements and extends the application and range of usefulness of cholecystography.

We wish to express our thanks and appreciation to Dr. Allen Phillips and Dr. William Burton for their help in gathering the statistical material.

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# THE FORMATION OF GALLSTONES

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ONE of the most remarkable mechanisms of the body is the delicate device of balance and counterbalance by which the different constituents of the normal body fluids, together with those substances which may be occasionally or abnormally added to these fluids, are maintained in a state of solution; or, to express the same thought from the opposite point of view, the mechanism which prevents the formation of precipitates. The effectiveness of this system depends not only upon the maintenance of balance between positive and negative ions, upon the mutual protective action of colloids, and upon other delicate balancing mechanisms, but also upon the presence of a normal lining wall of the cavities and spaces in which these fluids are contained. The relation of injury to the intima of the blood vessels to clot formation, or the formation of precipitates in inflamed bursae, are well known examples of the importance of normal lining walls to the solubility relationships of body fluids.

When a gland of the body is called upon to remove materials from the blood stream, perhaps to change their chemical character, certainly to concentrate them and to excrete them into a further system of collecting tubes, new solubility relationships must be introduced. The preservation of these interrelationships must be guaranteed by a normal lining of the excretory channels. A parallel with the circulating blood is here seen in the need for maintaining the normal lining wall. A striking difference exists in one respect—the balance of the solubility relationships in the blood stream is being constantly maintained as the blood flows through the organs where these various factors are initiated. But under the circumstances of

excretion, once the materials have passed out of the gland cell into the excretory duct there is no further chance to correct any abnormalities.

Such is the case in a simple system such as the excretory system of the kidney, if we consider this system as beginning at the kidney pelvis. No additions to or subtractions from the urine occur beyond this point; but, if we should consider the excretory system of the kidney as beginning with the glomerulus, the statement that solubility relations of the excreted fluid are not changed would be completely inaccurate, for as the urine passes down the kidney tubule, subtractions certainly occur, even if no additions are made.

Perhaps our idea of liver function and bile excretion would be more accurate if we thought of it in the light of the modern concept of kidney function. The liver cell corresponds to the glomerulus; the bile ducts down to and including the gall-bladder and cystic duct are comparable to the kidney tubule, certainly adding mucin and certainly abstracting water, both processes inevitably changing solubility relationships. Looked at in this way, the true excretory duct of the liver would be the common duct only. It is interesting to note that the parietal sacculi discovered by Theile,<sup>1</sup> known to the older anatomists and forgotten by present day students of the anatomy and pathology of the biliary system, are said to occur along the bile ducts both inside and outside the liver down to the opening of the cystic duct, but not along the common duct below this point.

The biliary system certainly possesses a structure which sets it apart from all the other excretory ducts of the body, namely, the gall-bladder. There is no agreement as

to the function of this organ. Opinions vary from the opinion first expressed by Heister 200 years and more ago, that it is a simple storehouse (although Heister admitted that changes take place in the bile in the gall-bladder). Owen<sup>2</sup> stated that, "the gall-bladder is not, however, a simple reservoir; its vascular and secreting inner surface can operate upon the bile by both subtraction and addition." From this opinion one may go all the way to the other extreme, namely, my own conviction<sup>3</sup> that the gall-bladder is an organ of absorption, that "under normal conditions, whatever passes into the gall-bladder through the cystic duct, never passes out again through the cystic duct."

Whether one wishes to think of the gall-bladder as a pressure regulating chamber or as a complicated mechanism for the resorption of biliary constituents, we must all admit that gallstones, once formed in the gall-bladder, can hardly get out again without surgical aid. We know, of course, that gallstones do erode through the gall-bladder wall and thence into other parts of the body, appearing in most unexpected places; but it is obviously a gross error to permit gallstones to follow any such path.

There is a function of the gall-bladder to which attention was called by one Rudolph Virchow many years ago.<sup>4</sup> This was before the day of the invention of the microtome and the aniline stain, when microscopic anatomists were dependent upon the technique of teasing out fresh cells and studying material perhaps more nearly normal than is the pickled, fried, extracted and lipsticked product which nowadays arrives at the anatomist's microscope.

Figure 1 shows the gall-bladder cells as shown by modern technique: high columnar cells, a relatively large nucleus in the lower third of the cell, the cell body apparently filled with large vacuoles.

Figure 2 shows gall-bladder cells prepared by the methods used at the time that Virchow described them, filled at certain stages of digestion with highly

refractile globules, which, as Virchow described them, appear first in the free edges of the cells, later completely fill the



FIG. 1. The normal gall-bladder mucosa, stained with eosin and hematoxylin. High columnar cells, nucleus in lower third, cell bodies filled with what appear to be large vacuoles.

cells, as shown in Figure 2, and finally are found only in the lower portions of the cell. Virchow concluded from this that they are in the process of absorption from the bile and are excreted into the tissue spaces.

If these cells are now studied through the crossed Nichols prisms, the majority of the globules show the brilliant double refraction which is by some thought to be characteristic of the esters of cholesterol. (Fig. 3.) I fear that positive proof that this material is an ester of cholesterol has not been forthcoming. It is intriguing, however to think of this finding of Virchow's in connection with the facts of cholesteroses and to think of certain types of gallstones as a result of a disturbance of this specific gall-bladder function, a function,



which, by the way, on the removal of the gall-bladder, is taken over by the parietal sacculi along the biliary ducts.<sup>5</sup>

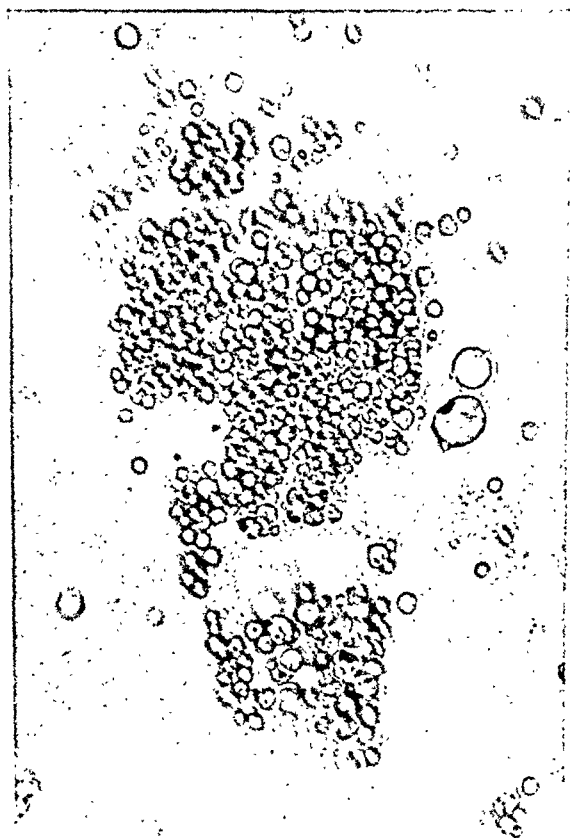


FIG. 2. Four fresh unstained cells of the mucosa of the gall-bladder. The free edges of the cells are at the top; the narrow pointed cell ends are at the bottom. The four clear areas are the nuclei.

There is also a suggestion in the literature<sup>6</sup> that there may be a relationship between vitamin D and the gall-bladder. If the double refracting granules shown in Figure 3 are indeed sterol, then it might be possible that the gall-bladder wall is engaged in recovering sterol from the bile and making of it the mother substance of vitamin D. In this connection one should think of the relation of certain kidney stones to vitamin A deficiency.<sup>7</sup>

It should be noted that the biliary system is called upon to care for three materials which are not readily soluble under the best of circumstances: calcium, cholesterol, and the bile pigments. Even under the too little understood conditions which preserve these substances in solution in the

bile, the mechanism which keeps them in soluble form seems to be the most delicate of the solubility relationships, as proved

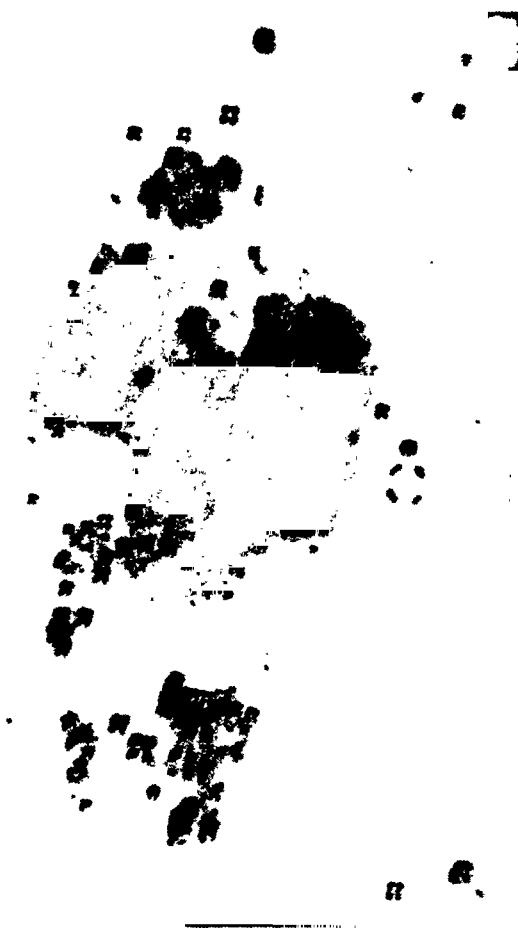


FIG. 3. The same specimen as in Figure 2, under the crossed Nichols prisms. The four nuclei now appear as black areas. Note that not all the brightly refractile globules seen in the surrounding fluid in Figure 2 now show the double refraction.

by the fact that the precipitates formed are composed of these three materials, calcium, sterol and pigment, with the sterol far outweighing the other two.

It becomes evident, therefore, that the precipitable constituents of the bile may not remain in solution under any one of four conditions. First, some one constituent, or several constituents together, may be excreted from the liver cell in an abnormal state due to a disturbance of the general body metabolism governing the materials in question. This material arriving in the gall-bladder, being abnormal,

could not be handled normally,—whether by resorption or by expulsion—and would therefore collect. This would seem to be the explanation of the formation of gallstones during pregnancy; these stones are usually single and composed largely of cholesterol. But let us not jump to the conclusion that the fault lies in a simple cholesterolemia; if cholesterol is maintained in the colloidal state by the mutual protective action of colloidal calcium, the fault might lie in the metabolism of calcium rather than in the faulty metabolism of the sterol.

Second, if the gall-bladder is engaged in the resorption of sterol, a disturbance of this resorbing function might result in a damming back of sterol in the gall-bladder, causing either cholesterosis or the formation of certain types of stones. (Fig. 4B.)

Third, a reflux into the common duct, perhaps of intestinal content and certainly of pancreatic juice, may occur when, as most commonly happens, the pancreatic duct opens into the ampulla. This may result in precipitation of all the constituents of both bile and pancreatic juice, which seems to be the explanation of what the surgeon inelegantly but descriptively calls "mud." Sometimes this material gathers into a mass moulded by the space in which it collects, the dilated common duct; the mass shows no internal structure, and on drying, characteristically breaks into many fragments. This is, in my opinion, the true common duct stone, that is, a stone which is formed due to disturbances in the common duct itself.

Fourth, the solubility relationships in the bile are changed by infectious processes which injure the lining membrane of the biliary passages and permit the entry of abnormal constituents into the bile. This is the most common cause of gallstone formation.

The injury to the lining wall of the excretory ducts of the liver is not the swelling and erosion of the mucosa, characteristic of the advanced stages of cholangitis, but is to be sought in that very early stage when microorganisms seem to

be filtered out of the blood stream and gain entrance to the bile passages. It is not clear where these organisms are living and

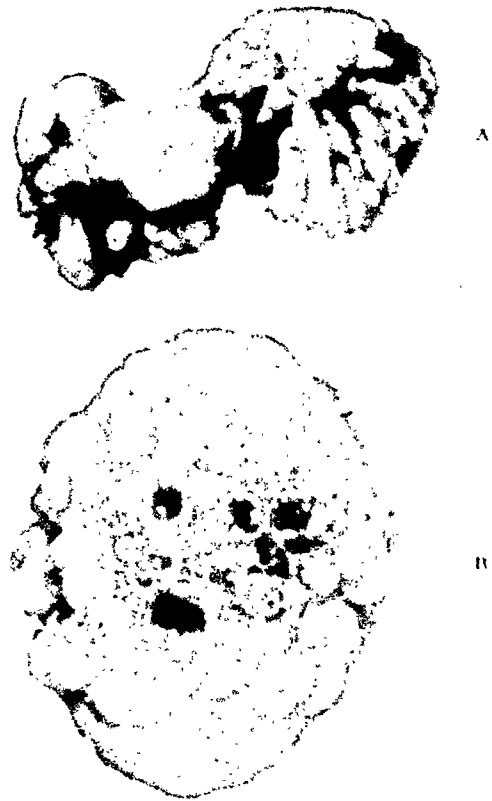


FIG. 4. A gallstone formed A, by direct crystal growth, and B, by coalescence of smaller stones. (From Sweet, in *Ann. Surg.*, 101: 624, 1935.)

multiplying, but they are being constantly excreted into the bile, bringing with them either additions from the blood serum or products of their own metabolism which alter the solubility relationships of the surrounding bile. Probably in many instances this process is finally overcome in the body and the gallstones which have formed are the only signs left of the previous existence of infection. On the other hand, in too many instances the infection extends downward along the ducts, finally involving the entire system, including the gall-bladder wall. It is at this period that the symptoms of gallstone disease first appear, not, however, because gallstones are present, but because the process which was responsible for the formation of the gallstones has now ex-

tended to involve the motor and sensory functions of the common duct.

It has been many years since the sphincter muscle surrounding the opening of the common duct was described by Oddi, but it has been only recently that any satisfactory proof of the function of the sphincter has been offered. Experimental work upon the commonly used laboratory animals in respect to the biliary system has never been entirely satisfactory. The bile of the cat and dog is a product quite different from the colloidal solution found in the human gall-bladder. The cystic ducts of these animals do not contain the valves of Heister and the erect posture of the human must introduce factors not to be found in the four-footed animals. It must be due to some or all of these factors that nothing comparable to human gallstones has ever been reported in these animals. The recent work of Walters and his colleagues<sup>8</sup> demonstrates the existence of a functional sphincter in the human being. It proves what has long been held by various authors that the filling of the gall-bladder is a passive operation due to the closure of the sphincter of Oddi in the intervals between active digestion and the consequent building up of sufficient pressure in the common duct to force bile into the gall-bladder. This recent work also seems to have established beyond question that the symptoms of biliary disease arise in the common duct and that the gall-bladder itself takes very little, if any, part in the inception of the characteristic symptom complex.

The concepts of modern chemistry render obsolete the earlier work on the formation of gallstones which was based upon the observations of crystallization around a central nucleus. This earlier concept was not at all satisfactory, for certain insuperable difficulties were encountered. It does not explain the rather common finding of stones which have no nucleus, but, on the contrary, a space filled with a clear fluid. Nor does the concept of successive lamination satisfactorily explain the internal

structure of the gallstone. The application of the ideas of modern colloidal chemistry does, however, explain the formation of stones with a central cavity, and also, not only the regular laminations found in round stones, but the peculiar structure of an irregularly shaped stone.

The work of the colloidal chemist Liesegang first demonstrated that the precipitation of a material contained in a colloidal mass by another substance which diffuses into this colloid mass does not cause a uniform precipitation but a series of rings precipitated in rhythmic order. Many examples are found in nature of this process, the most commonly known being the precipitation of iron salts diffusing into a silicon gel, producing the colored rings of the agate. The comparable situation in the process of gallstone formation<sup>9</sup> is the formation of a gel of colloidal cholesterol and some calcium compound in the colloidal state. The bile pigment diffusing into this mass precipitates in rings of calcium bilirubinate or calcium biliverdinate or calcium bilifuchsinat, giving rise to the vari-colored rings. The colloidal calcium, being thus changed from its colloidal state, ceases to exert a protective action on the colloidal sterol, which, therefore, changes into the crystalline form of needles or flat plates. The gallstone with a central cavity develops simply because the material in the colloidal state occupies more space than when the molecules have been arranged in the orderly fashion of the crystal.

The belief that these structures must arise in this fashion is based upon a study of the internal structure of the gallstones.

In Figure 5, A and B show the Liesegang ring formation and C shows how beams of crystals pass through these rings, indicating that the crystallization process was subsequent to the formation of these rings. Figure 5C also shows how the crystals in process of formation may have pushed pigment particles into the center of the mass.

A common example of the process of crystal formation is found today in the

freezing of ice cubes in an electric refrigerator.<sup>10</sup> Ice crystals first form around the sides and bottom of the ice cube, with

as though the structure were laminated, and the crystals will assume a radial form. This would also be the case if the Liesegang



A



B



C

FIG. 5. A, B and C, examples of Liesegang ring formation in gallstones of round or oval form.

crystals extending toward the center until finally the complete crystallization has taken place with the freed air bubbles elongated by the in-growing crystals and pushed into the center of the mass.

The formation of a distinct cross can often be seen in ice cubes, a picture which is characteristic of the internal structure of irregularly shaped gallstones. (Fig. 6.) The process of diffusion into a gel and the process of crystal formation as seen in the ice cube proceed in straight lines perpendicular to the surface, therefore in a round mass (Fig. 7, 1 and 4), the rings of Liesegang will lie parallel to the surface

process or the crystal formation started from the center toward the periphery. In such a case the crystals would radiate from the center, regardless of the external form of the mass. (Fig. 7, 1-2-3.) But if the colloid mass assumes an irregular form, as in Figure 7 (5 and 6), the diffusion process, as well as the crystallization process, if it starts from the outside of the mass, meets opposing forces which started at the same time from the other surfaces, resulting in characteristic disturbances at the angles. These opposing forces may either stop before meeting (as in Fig. 7, 5), or the lines may meet and cross, intensify-

ing the process, and even giving the effect of a central nucleus (Fig. 7, 6), just as cross hatching is used in an etching or dry

great numbers of gallstones of essentially the same size and shape.<sup>11</sup> It became necessary further to assume, on the basis of



FIG. 6. The result of the Liesegang process in a cuboidal stone, 1, and in a pyramidal stone, 2.

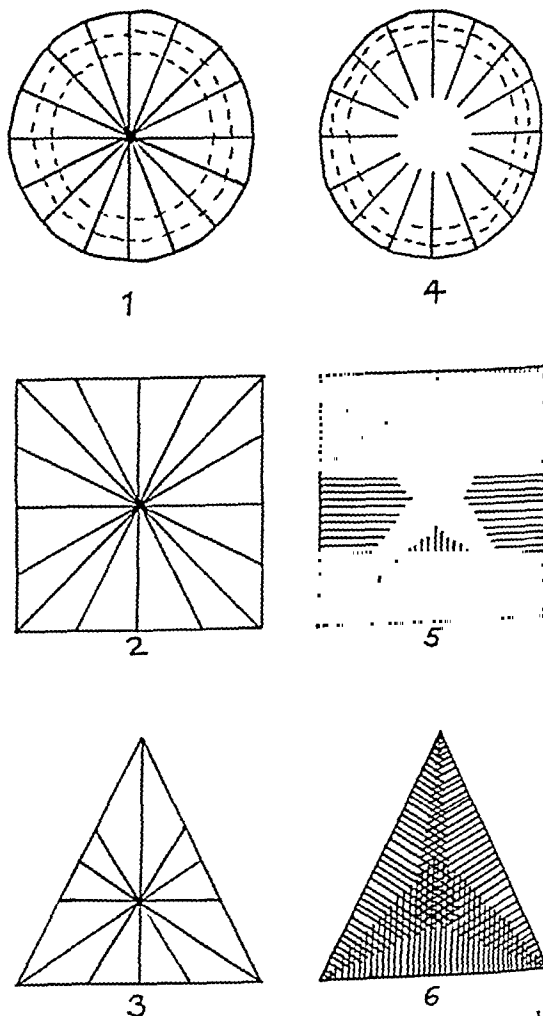


FIG. 7. Schema of the results of a diffusion or crystallization process, beginning at the center, 1, 2 and 3, or beginning at the outside, 4, 5 and 6.

point to increase the depth. This finding in the irregular shaped stones (Fig. 8), convinces me that no other explanation of gallstone formation is adequate to explain what is actually before us.

One finds, occasionally, gallstones so different in their form that one must assume a different process of formation, such as in Figure 4A, a rare type of pure cholesterol stone, evidently formed by a direct addition of crystals. A more common type of stone is seen in Figure 4B, a stone often associated with cholesterosis of the gall-bladder, where small masses of cholesterol collect into larger masses and seem to fuse with the larger mass, perhaps on the same principle that the globules of butter forming in the churn gradually unite into larger and larger masses.

A problem which has been impossible of solution on the basis of the old idea that gallstones arise around a central nucleus and continue to grow, has been to explain the finding, so common in a gall-bladder, of

the idea of the gallstone which continually grows, that there must occur in the gall-bladder a shower of nuclei, the number of which predetermines the number of gallstones. One then had to assume that material was deposited equally on all sides of each and every nucleus. Mutual pressure was then assumed to account for their final form, but it did not explain why this mutual pressure should result in such varied forms in different gall-bladders.

If we agree that the internal structure of gallstones points without question to the colloidal state or gel in which the original

mass must have existed, then we can find an explanation for the production of multiple stones of the same size and shape. This

of the gall-bladder wall and pouring the gallstones down the sink, they reverse the process and instead of studying the

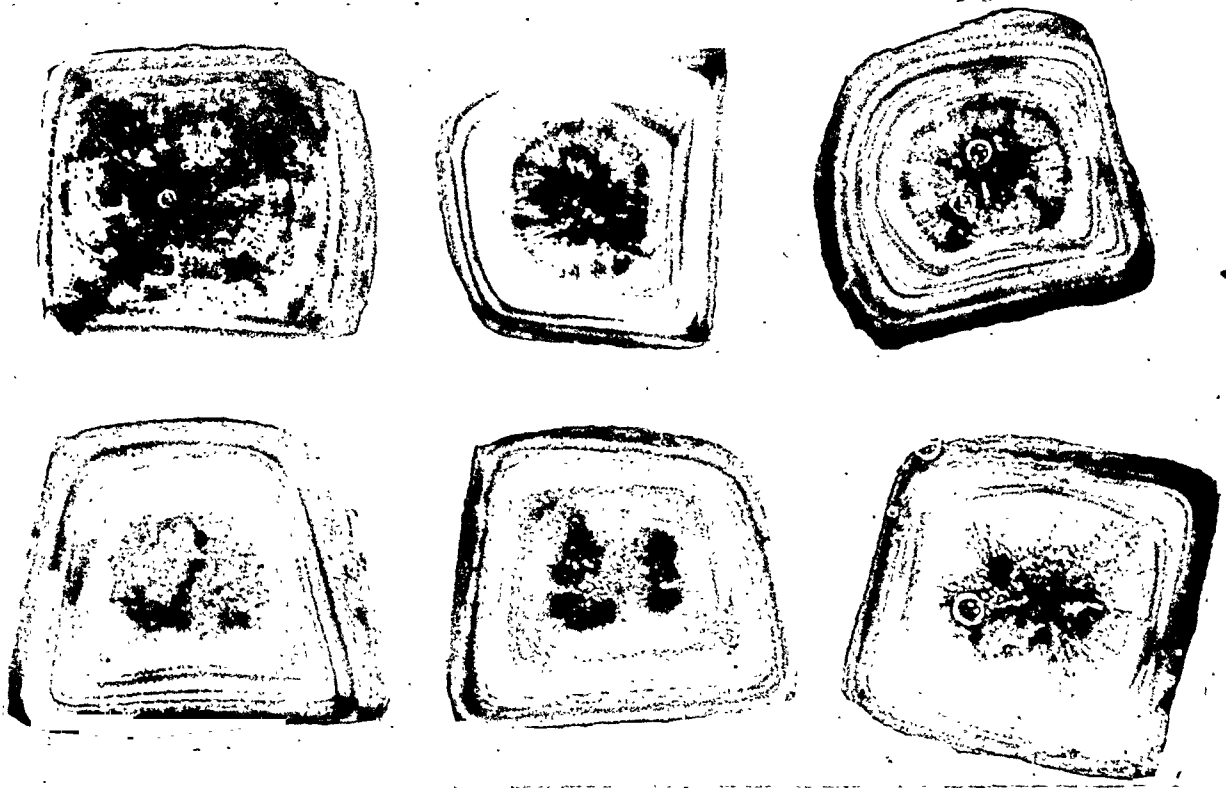


FIG. 8. Gallstones of irregular form, showing the effects of angles upon the formation of the Liesegang rings. Photographed under water, hence the air bubbles.

plastic gel is moulded into the size and shape of the finished stone, and the mould is found in the spaces created by the valves of Heister, in the neck of the gall-bladder and in the cystic duct. After the mould is filled, the material is ejected from the mould by the pressure of the bile being secreted by the liver against a closed sphincter of Oddi. When this pressure is insufficient to dislodge this moulded mass we find a stone impacted in the cystic duct. Such masses of gel have been reported in the gall-bladder and will be found more frequently when the operating surgeon starts looking for them.

It has been my own experience that a case history can be reconstructed far more accurately and completely from a study of the gallstones than from the study of the sections of the gall-bladder. I recommend to surgeons and hospital pathologists that now, after fifty years of studying sections

bag in which the stones have collected, they devote their thought to the study of the structures which, like so many comparable geological formations, contain in themselves a record of their past history.

I would call the attention of the clinical surgeon to the following facts. First, gallstones may be, but are not necessarily, the product of a disturbance of gall-bladder function. Second, the removal of the gall-bladder, by causing a dilatation of the common duct, permits a constant drainage of the biliary tree, so that any materials in the bile which tend to fall out of solution, will be washed out into the intestine; but such materials can collect in the common duct and form gallstones after the removal of the gall-bladder.

It has become increasingly clear of recent years that the ultimate results of operative procedures on the biliary system differ according to the pathology encount-

ered at the operation. The final result in cases of biliary disease with cholelithiasis are satisfactory in a much higher percentage of cases than are the results following operations where no gallstones are found. If the reasoning followed in the earlier part of this paper is correct, the presence of gallstones must indicate that a different process is going on even though cholangitis be associated with the cholelithiasis, than in the cases where no gallstone formation is encountered. Gallstones are a product of a long continued chronic process which takes its origin in the finer radicles of the biliary system, a process which may gradually extend downward until the whole biliary tree is involved. A cholangitis without cholelithiasis may be a lymphangitis of the walls of the larger bile ducts, is a more acute process, and may be limited to the walls of the bile ducts and not effect the solubility relationships of the contained bile.

Third, the chronic disease, cholelithiasis, gives time for the gradual dilatation of the common duct, which dilatation involves the ampulla and the sphincter and permits a freer drainage of the biliary tree. If this dilatation has not occurred prior to opera-

tive interference, it is brought about by cholecystectomy. The operation, therefore, ordinarily cures cholelithiasis because in the absence of a gall-bladder and with free drainage from the common duct there is no place for material to collect and form stones. On the other hand, if cholangitis without cholelithiasis is simply a lymphangitis of the walls of the bile ducts it is an entirely different pathologic entity from cholelithiasis with or without cholangitis, and one would not necessarily expect it to be cured by the removal of the gall-bladder.

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# SOME OBSERVATIONS ON NORMAL AND PATHOLOGIC LIVER FUNCTION\*

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THE liver in both fetal and later life is the largest organ in man. Its actively functioning tissue is exceeded in man only by the total voluntary muscle. It is an organ of manifold functions. It has certain specific characteristics, the most prominent of which is its double blood supply: arterial blood from the hepatic artery, which is a branch of the celiac axis, and portal venous blood from a portion of the intestinal tract and spleen. The arterial blood is similar to the arterial blood supplying the remainder of the body tissues, but the venous blood has already passed through a capillary bed. It comes from the spleen and that portion of the intestinal tract from which the split products of digestion are absorbed. Any toxic substances present in the proximal gastrointestinal tract may also enter the circulation by this means. Certain of the products of digestion are not in a state in which they are prepared to enter the general circulation and thus become available for general tissue metabolism. The interposition of the liver between the portal and the general circulation is, therefore, of great importance. Not only is the liver capable of making important changes in these substances, but it synthesizes others, such as the bile salts, which are important in maintaining normal digestive processes; it synthesizes others which are in the main excretory in character, such as the bile pigments; it is the site of origin of various enzyme systems; and it is one of the most, if not the most, important storehouse of labile carbohydrate and protein. Furthermore, it is capable of detoxifying various substances of a toxic nature and through

its external secretion, the bile, it can eliminate certain products of metabolism and toxic or foreign substances some of which may be the result of cellular activity, and others of which are the result of ingestion or administration. Mann<sup>1</sup> has shown that life is impossible when the total liver mass has been removed. The liver is, therefore, necessary for other important systems to survive. It is also well known that complete occlusion of the hepatic artery is not compatible with life.

It is essential for clinicians to know in general what the major functions of the liver are, the margin of reserve which must be present before gross incompetency can be demonstrated, and the help which can be obtained in clinical practice from the functional tests now available. It is impossible in this short review to discuss all of the functional activities of the liver and the many tests suggested to determine functional capacity. It is, however, of value to show that many of the most important of hepatic functions can be maintained when only a small part, 20 per cent, of the total liver mass remains normal, and to stress the fact that a test for a single function is often completely inadequate to give information on the impairment of other functions of the liver.

## CARBOHYDRATE FUNCTION

While glucose is the main carbohydrate of the blood, glycogen is the main carbohydrate of the body tissues. Under normal conditions the body tissues, chiefly muscle and liver, contain approximately ten times as much glycogen as the glucose present in the body. The most abundant source of

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glycogen is the liver, and it is the liver glycogen which maintains the blood sugar level, for the muscle glycogen is converted into lactic acid, which can become glucose only after the reconversion of the lactic acid into liver glycogen. The concentration of the liver glycogen depends in large part upon the condition of the polygonal, parenchymatous cells of the liver lobule, the efficiency of the hepatic blood supply, and the state of nutrition of the individual. Shortly after the ingestion of a meal containing a large amount of carbohydrate and protein the concentration of liver glycogen increases greatly if the accessory conditions are normal. During starvation, or food deprivation, the liver glycogen is rapidly depleted. While the liver can form glycogen from glucose, from other sugars, and from substances derived from protein, other tissues of the body can form glycogen only from glucose.

Some years ago Sansum and Woodyatt<sup>2</sup> found that a normal 70 kilogram man could utilize 60 Gm. of glucose per hour without glucose spilling over in the urine. Since only 15 Gm. were necessary to meet the basal metabolic requirements, 45 Gm. per hour, or 75 per cent of the glucose injected intravenously, could have been stored as glycogen.

The importance of determining whether the liver glycogen concentration is adequate for normal function is based upon several observations. Hypoglycemia produces profound physiologic disturbances and if the liver glycogen is so depleted that glucose cannot readily be formed upon demand, the blood sugar drops from its normal level. Since the observations of Opie and Alford<sup>3</sup> we have come to believe that the presence of an adequate concentration of glycogen in the liver protects this organ against the deleterious effects of the volatile anesthetics and certain other substances capable of producing serious liver injury. It was Rosenfeld<sup>4</sup> who first stated that when the liver glycogen is high, the liver fat is low and it has been demonstrated that a liver high in fat con-

tent is more susceptible to these same noxious agents.

This line of reasoning has without doubt lulled clinicians into a sense of false security for they have believed that by providing adequate carbohydrates by mouth or vein, liver injury may be prevented. While in the main this is true, observations which we plan shortly to publish demonstrate that the inverse relationship between glycogen and fat is not constant, for it is possible to have high glycogen and high fat concentration in the liver at the same time. Under such conditions the glycogen, even though it be several times the normal concentration, will not protect the liver from the injury imposed by volatile anesthetics if the fat concentration is only slightly above the normal level. The major conditioning factor for liver injury following the use of volatile anesthetics is, therefore, the amount of fat present in the liver and not the amount of glycogen.

An excessive hyperglycemia can be assumed to indicate an impaired capacity of the individual to take care of the ingested glucose. Heyd, MacNeal and Killian,<sup>5</sup> Lichty and Woods,<sup>6</sup> and von Fejer and Hetényi<sup>7</sup> have found that an alimentary hyperglycemia is often associated with long standing cholecystitis and hepatitis. Moderate liver injury may be associated with a persistent hyperglycemia. Bodansky<sup>8</sup> and Hetényi<sup>9</sup> first showed that the hypoglycemic response to insulin might be prolonged in patients with extensive liver disease. It has been observed by clinicians for some years that the patient with liver disease and diabetes mellitus is most difficult to standardize, for he can easily pass with a small dose of insulin from a hyper- to a hypoglycemic level. In very advanced hepatic disease hypoglycemia may be present.

Many tests have been devised to determine whether the liver can store glycogen normally and whether a normal concentration of glycogen is present to supply the tissue needs of glucose. The glucose toler-

ance test has been widely used for determining the capacity of the liver cells to store glycogen. As a rule from 50 to 100 Gm. of glucose are ingested and the arterial or venous blood sugar curves, or both, are followed for from two to three hours. The venous curve is more generally followed. The venous blood sugar rises rapidly after ingestion of the glucose and reaches its peak of from 140 to 160 mg. per cent in twenty to forty-five minutes. Within one and a half to two hours the venous sugar level reaches its original or an even lower level. Certain investigators have used levulose or galactose for their studies, while others have studied the urine for its sugar content as a means of determining the amount of sugar which the tissues were not able to take care of. The preferable time for testing is the morning on a fasting stomach; disturbing psychic or physical effects should be minimized.

Unfortunately so many accessory factors may exist when liver injury is suspected, which affect the glucose tolerance test, that its effectiveness as a measure of hepatic function has been small. The information which one obtains is at best uncertain. Greene, Snell and Walters<sup>10</sup> believe that the tolerance for levulose is more frequently affected by hepatic disease than is the tolerance for glucose and they have suggested that levulose be used for a function test. Further experience has shown that levulose is of only limited usefulness.

The clinical value of any of the sugar tolerance tests is not great. Considerable liver destruction may be present and the tolerance tests may still be normal. Acute liver injury, of even only limited extent histologically, may cause marked changes in the tolerance curves, while chronic injury of a more extensive character, may be associated with a normal tolerance curve. At this time one must admit that blood sugar determinations will not aid the clinician very much in the diagnosis of hepatic disease. The important thing from the standpoint of the surgeon is to

administer as much carbohydrate by as many routes, and over as long a time as is possible before subjecting the patient to operation. Even under the conditions of complete common duct obstruction, considerable amounts of glycogen may be stored in the liver if the administration of carbohydrate has been vigorous and persistent.

#### LIPOID FUNCTIONS

Under this heading come the fats and a variety of substances which resemble them, but although they are grouped together chemically they are dissimilar functionally. From the viewpoint of brief discussion I shall consider only a few substances.

Although the enzyme lipase is not a lipid it is so closely associated with fat metabolism that it may well be considered here. The ingested fats are hydrolyzed chiefly by the lipase of the pancreatic juice and the succus entericus. The importance of the liver in this process lies in the fact that bile facilitates it, for bile aids in the emulsification of fat and in the activation of lipase. Although there is some evidence that certain sterols can be absorbed from the intestinal tract which contains no bile, it cannot be denied that the absence of bile from the intestine causes a profound change in the ability of the individual to handle ingested fat.

The fatty acid concentration of the liver varies considerably and rapidly, both in health and disease. Leathes and Raper<sup>11</sup> have suggested that the liver is the site of desaturation of fatty acids and that this process is necessary before oxidation can take place. Although this may not be absolutely necessary on the part of the liver, as was shown by McMaster and Drury,<sup>12</sup> it can hardly be denied that this is probably the usual event in the intermediary fat metabolism.

Cholesterol, which is a lipid, is one of the most important constituents of the bile. There is considerable difference of opinion as to whether the ingestion of an

excess of cholesterol results in an elevation of the bile cholesterol. The results of Wright and Whipple<sup>13</sup> in the experimental animal suggest that such a relationship exists, but observations which we have made in man give little support to this concept. The fact that most gallstones consist largely of cholesterol and that obese individuals are more prone to have stones suggests that disturbances in lipid metabolism may in part be responsible for gallstone formation.

Cholesterol is found in the bile only as free cholesterol, while in the blood it is also present in the combined state. It is maintained in its normal state in bile by the bile salts. Both of these substances aid in the emulsification, digestion and absorption of fats in the intestine. Thannhauser<sup>14</sup> has suggested that the bile salts are synthesized from cholesterol. It has frequently been intimated that cholesterol is an excretory product, but these facts would make it appear that it must be considered as a more important substance.

The ease with which fat may enter the liver cells is of interest, for fatty infiltration is of common occurrence. It may be seen in the early period of starvation, and following the administration of various anesthetics and chemical substances, such as carbon tetrachloride, which affect hepatic functional activity. Since an excess of liver fat may predispose to serious liver injury following anesthesia, its presence in amounts above the normal has more than a scientific interest.

The results of blood lipid studies in hepatic disorders have, however, been disappointing. Hypercholesterolemia is present during pregnancy, and pregnancy and gallstone disease are closely related. However, studies by ourselves and others have shown no relationship between established gallstone disease and hypercholesterolemia. In common duct obstruction the blood cholesterol is frequently considerably elevated. On the other hand, in cholangitis and extensive liver injury hypocholesterolemia is more apt to be found. Wright<sup>15</sup> and

Thannhauser and Schaber<sup>16</sup> have found that severe hepatitis reduces the ratio in the blood of ester, or combined cholesterol, to free cholesterol. The impairment of fat absorption from the intestine which may occur in extensive liver disease cannot be distinguished from a similar process which is seen when there is a disturbance in the external secretion of the pancreas.

It is unfortunate that as yet our knowledge of the factors which determine the level of the lipid constituents in the blood is still meager. Not only is this true in regard to normal function, but it is also true in relation to disease processes. Until the intricate processes controlling fat and sterol metabolism are better understood the help which may come from careful studies of blood lipid fractions will be denied us.

#### PROTEIN FUNCTIONS

The importance of the liver in protein metabolism has apparently not concerned surgeons as much as has the metabolism of carbohydrates and fats, and yet with the information now available we may well assume that the protein functions of the liver are as important, if not more so, than those of the other primary food constituents. It would seem highly likely that the major source of mobile protein is in the liver. This may be true in regard to protein for energy requirements, tissue growth and for the maintenance and restoration of the serum protein which plays so important a part in keeping fluids in the blood vessels.

Since the synthesis of urea is a function of the liver cells, it is possible that disturbances in hepatic activity may be reflected in an inability of the cells to synthesize this substance. Considerable changes of the non-protein nitrogen in the blood are usually associated with variations in the concentration of urea. Bollman, Mann and Magath<sup>17</sup> demonstrated that after total hepatectomy in the dog, amino acid nitrogen in the blood rises while urea nitrogen falls. Similar changes have

been described following acute yellow atrophy, chloroform poisoning, and the serious degenerations occasionally accompanying common duct occlusion. Thus the total non-protein nitrogen may or may not be altered, but the partition of the components making up the total non-protein nitrogen may be considerably changed. In advanced surgical hepatic disorders, and in extensive cholangitis and complete common bile duct occlusion the blood non-protein nitrogen is frequently elevated. It has been falsely assumed that variations from the normal blood concentration can be taken as a measure of hepatic derangement. An increase in the non-protein nitrogen is not *prima facie* evidence that the increase is attributable to liver injury, for it may be in part or in whole the result of impaired renal function, increased nitrogen breakdown, or dehydration, any of which may be present during serious surgical liver or bile duct disease.

Nevertheless, numerous liver function tests based on the urea-forming ability of the liver have been devised. Proteins, peptones and amino acids have been fed and an attempt made to determine whether these products were being converted into urea in a normal manner. The reserve capacity of the liver is so great that almost complete destruction of the organ must take place before the liver fails to transform amino acids into urea. At such a time a function test is not required. It is in the chronic liver states that a function test would provide diagnostic help, but the studies reported by Witts<sup>18</sup> show of how little practical diagnostic value these tests are. This applies to studies of the urea and amino acid concentrations.

Bollman and Mann<sup>19</sup> found that complete removal of the liver was followed by the excessive excretion of uric acid. Even moderate degrees of liver injury were accompanied by a more than normal amount of uric acid excretion. They believed that the urinary uric acid was a more delicate index of hepatic injury than was the carbohydrate metabolism or urea

formation. These generalizations were, however, not substantiated by Wakeman and Morell.<sup>20</sup> Bornstein and Griesbach<sup>21</sup> reported an increase in the blood uric acid in cholecystic and hepatic disease, while Stander<sup>22</sup> has found a high blood uric acid in a patient with fatal chloroform poisoning. Promising as such data may seem, Rabinowitch<sup>23</sup> failed to find a rise in the blood uric acid in a fatal case of acute yellow atrophy.

The blood fibrinogen is formed, at least in large part, in the liver, but again, even under the conditions of complete common duct obstruction the blood fibrogen concentration is not reduced. Only extensive destruction of the hepatic parenchyma causes a reduction of the blood fibrinogen. The early optimism of Full<sup>24</sup> that determinations of the blood fibrinogen would be of practical diagnostic import in moderate liver disease has long since been lost and the level of the other protein constituents of the plasma are little effected by early or moderate liver injury.

#### OTHER FUNCTIONS

*Hippuric Acid Synthesis.* When benzoic acid is given by mouth only a portion of that ingested is excreted in the urine as benzoic acid. The major portion of it is converted to hippuric acid and excreted in this form in the urine.

For a time it was supposed that this synthesis could be used as a test of renal function. Following the work of Friedman and Tachau<sup>25</sup> and more recently Armand Quick<sup>26</sup> it has been suggested that this synthesis could be used as a test for hepatic function. Although Delprat and Whipple<sup>27</sup> found changes only in the presence of extreme liver injury suggesting that the method had no value in clinical work, the studies of Quick<sup>26</sup> are more encouraging. His modification of the test for hippuric acid conjugation may be of some value in the patient with doubtful liver injury.

*Bile Pigments.* The bile pigment, bilirubin, may be increased in the blood by a

number of factors. Liver injury and common duct obstruction are the two most common surgical lesions causing a hyperbilirubinemia. Determinations of the bilirubin concentration in blood should not be used as liver function tests, but they afford evidence of the ability of the liver in hepatic disease to excrete bilirubin in the bile.

Of the clinical methods now available we believe that the Van den Bergh reaction is the most accurate for determining the amount of bile pigment in the blood stream. It is not affected by articles in the diet which may cause a marked deviation from the normal findings when the icterus index of Meulengracht is used.

I believe that not only is the quantitative portion of the test valuable, but that when properly executed, valuable information can be obtained from the qualitative portion of the test. The observations of Snider and Reinhold<sup>28</sup> that high concentrations of bilirubin in the serum are invariably associated with a direct immediate reaction with the diazo reagent of Van den Bergh, while a low concentration is associated invariably with a delayed or negative reaction has not been substantiated in our patients. The more recent observations of Pedersen and Waldenström<sup>29</sup> in Svedberg's laboratory offer at last a satisfactory explanation for the immediate and the delayed or negative reactions. Used for what it is supposed to determine, the Van den Bergh reaction is an excellent test of a specific liver function.

#### THE DYE TEST

The use of bromsulphalein and sodium tetraiodophenolphthalein as liver function tests has been extensively employed. Rosenthal and Bourne,<sup>30</sup> Graham et al.<sup>31</sup> and others have reported that they may give valuable evidence of the state of liver competency. Within narrow limits this is true, but they are not, and should not be considered as tests which will provide information on the degree of impairment

existing in all of the hepatic functions. As auxillary methods of study they are worthwhile, but too frequently normal findings are obtained in a patients whose liver is competent until exposed to the insult of anesthesia and operation, when incompetency from a narrow reserve is manifested.

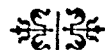
The many functions which the liver normally carries on simultaneously make it improbable that any single test will ever suffice to give information of practical diagnostic importance on the degree of variation from the normal affecting all of these functions in early or moderate hepatic disease. Conclusions drawn from testing one functional activity may not have the slightest application to other important hepatic functions. There is as yet no concrete evidence that cells in different portions of the lobule have specific functions. The evidence frequently given in support of such a hypothesis fails to take into account the environmental circumstances surrounding the cells of the lobule. No one has yet produced a set of characteristic findings or symptoms for injury of the central or the peripheral portions of the lobule alone. The complete functioning of the liver is dependent on many conditions some of which involve primarily the liver itself, but others of which are dependent on factors unassociated with the liver cell but in which liver damage takes place secondarily.

When such conditions as anoxemia, dehydration, hemorrhage, trauma and infection may transform a completely normal liver, histologically and physiologically, into a totally incompetent viscus, we must look with considerable prejudice at those tests which give us evidence of normal function when the major portion of the normal gland has already been destroyed.

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# DIAGNOSIS AND TREATMENT OF DISEASES OF THE GALL-BLADDER AND RELATED BILIARY DISORDERS\*

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**A** DIAGNOSIS of gall-bladder disease may be the simplest of medical tasks, or it may be the most difficult. The difficulties in diagnosis occur because of the striking tendency of the gall-bladder to reflect symptoms due to disease elsewhere, and in turn to be the cause of referred symptoms. Many other organs surround the gall-bladder, and, as Charles Mayo has said, "How diverse may be the paths through which painful sensations may leave the abdomen."

While the clinician may make a diagnosis of cholecystitis (being very careful of course to include that protective and qualifying phrase "with or without stones"), it is now generally accepted that the pathologic process is not limited to the gall-bladder, but that the entire biliary tract is affected to a greater or less extent. The problem of the physician, therefore, becomes finally not the cure of an acute condition, but the management of a chronic disease.

The gall-bladder must be considered a part of a system which includes the liver and biliary ducts, and the whole system shares in the pathologic process. Unless our therapy, especially our surgical therapy, removes the site of the major portion of the pathology, the disease and symptoms continue just the same. Frequently after the removal of a gall-bladder involved only to a minor degree, the compensatory dilatation of the biliary ducts and radicles only prolongs the disorder.

When a complaining or sick patient comes to us for diagnosis and advice, and an opinion has been rendered in favor of gall-bladder disease, we must, in order to treat such a case properly, have some con-

ception of the answers to the following queries:

1. What caused this condition to develop?
2. How long may it continue?
3. How should it be treated now?
4. What will be the after effects or pathologic changes?

The causes of biliary tract disease and the nature of the deranged physiologic processes, as far as they affect the gall-bladder, are quite generally conceded to be as follows: (1) biliary infection; (2) biliary stasis; and (3) metabolic disturbances (especially the lipoid). All our theories of procedure and treatment of this disorder rest upon our conception of the extent and relative importance of these factors, and all treatment is aimed at the relief or correction of the elements of infection, stasis and metabolic disturbance. Very different opinions exist as to the cause of inflammation of the gall-bladder and the formation of gallstones.

1. *Biliary Infection.* It has been well established that bacteria pass from the blood stream through the cells of the liver, that they reach the wall of the gall-bladder and the tissues of the pancreas by lymphatic channels, and that the infective organisms, which may be excreted in the bile, may cause inflammatory changes in any or all parts of the biliary vessels. A hepatitis is the first pathologic change created by such an invasion. It may be followed by a cholecystitis, but may be present without cholecystitis, and may persist long after the secondary cholecystitis has been cured. Jaundice is generally associated with hepatitis. Surprise is often expressed at the failure of surgical drainage or removal of

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the gall-bladder to relieve completely the symptoms of a long standing case of gall-bladder disease. This failure is in reality due to the hepatitis which has been present all the time, and which still requires time and care for a cure.

2. *Biliary Stasis.* It has been observed that after the ingestion of food, the cholecystographic shadow of the gall-bladder increases rapidly in density and size; then as it empties, its mucosa is thrown into folds, the viscus becomes partly collapsed and concentration of the bile occurs. It is conceivable, therefore, that in any condition in which the gall-bladder is partially collapsed and its refilling is prevented, concentration might go on to precipitation and theoretically to gall-stone formation. Conditions which would favor this occurrence would be:

1. Too often repeated stimuli to emptying (frequent meals and over-feeding).

2. Insufficiency of the sphincter of the common bile duct from atony, preventing refilling, a result of digestive faults and bad dietetic habits.

3. Pressure from without, as in pregnancy.

4. The above factors, associated with infection.

At any rate, we know that the gall-bladder is able to concentrate the bile some ten or twelve times, and it may well be that if any obstructive factor is present, such concentration may proceed to the extent of actual deposition of minute calculi, such as so-called bile sand and crystals of calcium bilirubinate and cholesterol.

Stasis, with its concomitants of over-eating, a sedentary life, lack of exercise and the incidence of obesity, certainly is a condition that must be reckoned with.

3. *Metabolic Disturbances Causing Gall-stones. Lipoid and Cholesterol Metabolism.* The majority of calculi of the biliary tract are largely formed of cholesterol; the other main group (much less common) are pure pigment calcium calculi. Widely divergent views are held as to the role of the gall-bladder in the formation of cholesterol. The

evidence in general favors the view that the gall-bladder absorbs cholesterol rather than that there is any secretion of cholesterol by the wall itself. In the light of these views Thomas R. Brown remarks:

"In fact, there is increasing evidence that the intake of lipoids by mouth plays little or no rôle in cholesterol metabolism. There is, therefore, slender evidence in favor of excluding oils, eggs, butter and cream and other fats from the diet of those with cholelithiasis except obviously in cases which are associated with jaundice, when, of course, reason for such exclusion from the diet is the well known deficient digestion of fats in the absence or limited presence of bile in the intestine, with its essential bile acids."

To this we might add also: Or when it is found that fats cause an inflamed and tender gall-bladder to contract too forcibly, thus giving rise to colic.

It is also of interest to know that in obstructive jaundice there is usually *hypercholesterolemia* which roughly parallels the degree of obstruction and bilirubinemia, and returns to a normal level with the relief of the obstruction. On the other hand, in degenerative diseases of the liver there is usually a marked divergence between the bilirubin and cholesterol content of the blood. The more pronounced the damage to the liver, the greater the *hypocholesterolemia* which accompanies the jaundice.

#### DIAGNOSIS

Tremendous advances have been made in the last few years in our ability to understand and diagnose disturbances of the biliary tract. The greatest single step forward in the last decade has undoubtedly been due to the development of cholecystography. However, the "case history" still remains the most valuable procedure, case in and case out, but it should be carefully taken and one should delve into the story not only of the present but of the past. The outstanding features of cholecystic disturbances include dyspepsias,



colics and jaundice. The first of these is invariably present; the others may or may not have occurred.

An analysis of the dyspepsia is most important, since gall-bladder disease may be latent, and the effect on the stomach may be vague and indefinite. Rehfuess comments on this dyspepsia as follows:

"Undoubtedly the most important single symptom of chronic gall-bladder disease is recurrent, flatulent indigestion. These people immediately after a meal, particularly a large meal, or a fat meal, suffer from bloating, upper abdominal distention, and seek relief in the regurgitation of gas or belching. This has all the earmarks of ordinary aerophagia. While it is true that aerophagia may be purely nervous and is probably due to some incoördination between the two sides of the autonomic nervous system, it is more frequently seen in gall-bladder disease than in any other form of abdominal disorder. In my experience, abdominal adhesions take second place as a cause of this phenomenon. The patient who comes to you complaining of bloating and distention after meals before any amount of real fermentation could take place and who seeks relief either by loosening his belt, or, if it be a member of the other sex, by opening her corset, is probably a sufferer from some form of gall-bladder dysfunction. This symptom is persistent, not readily controlled by diet, and all sorts of remedies are used in an attempt to overcome it. It is often associated with spastic constipation and the patient takes a large amount of aromatics, carminatives and cathartics, many of which in themselves are capable of causing digestive disturbances."

The dyspepsia may simulate peptic ulcer, with distress more apparent between meals as the stomach empties, with some relief from alkalis, but lacking the uniformity and regularity of the ulcer syndrome. This may be brought about by the mechanical irritation of the gall-bladder against the duodenum, by an associated duodenitis, or quite frequently by an accompanying duodenal ulcer.

The symptoms may then vary from the mildest, as belching, retasting of food, pyrosis, heartburn, a sense of epigastric fulness, pressure or weight, a mild distress or ache in the right scapular region which may have been diagnosed as neuritis or neuralgia for years. These mild symptoms may come and go, being present off and on for weeks and absent for months, as in the case of peptic ulcer. From these very mild symptoms the picture varies to the other extreme of excruciating pain. These latter attacks are frequently wrongly diagnosed as "acute indigestion" or "acute gastritis," neither one of which is really associated with pain. Thus the patient who has had these diagnoses made, usually ascribes them to some indiscretion in diet, faulty combination of, or spoiled foods and so dismisses the attack as being of no importance. They are usually not reported in the history unless specifically asked for.

The physical examination may be entirely negative. Positive findings depend upon the stage of the disease and the complications present. Right upper quadrant tenderness, the tender liver (Murphy's sign), Robson's point sensitiveness, a painful cystic tumor, and, in the back, ninth rib tenderness and a Head's hyperesthesia area may all or severally appear. Cholecystography, gastrointestinal roentgenograms, Lyon's drainage, gastric analyses, the blood, urine and stool examinations complete the ensemble.

The various liver function tests, which I will mention later, may be of supplemental importance, both in diagnosis and as indications for the operable risk.

#### INDICATIONS FOR SURGICAL AS AGAINST MEDICAL TREATMENT

In considering the disorders of the biliary system, that involve consideration of the gall-bladder as a primary or remote offender, the most intriguing and constantly challenging group are those with jaundice. Determination of its cause may be very simple if the icterus has followed an acute and classical colic attack, or if the

history clearly shows recurring short febrile crises, associated with mild or severe abdominal pains around or above the navel. Too frequently, however, this is not the case, and on arrival at the bedside we find a vague history of indigestion, unconvincing bouts of abdominal pain, no record

of the head of the pancreas or of the ampulla of Vater is greatly enhanced. Absence of bile in the stools and of urobilin in the urine indicates a complete block of the common duct and its persistence rules out catarrhal jaundice and other diffuse disorders of the liver, favoring then extra-

Diseases with Jaundice	Urobilin	Icterus Index	Van den Bergh	Galactose Tolerance	Modified Glucose Tolerance	Dye Tests	Cholecystography
Diffuse liver diseases. Intrahepatic jaundice.	Early o Late +++	High	1. Indirect 2. Biphasic 3. Direct	Positive Early	Impaired Early	High retention	Frequently visualized
Common duct stones..	Complete o Partial ++	Intermediate	1. Direct 2. Biphasic	Negative Early	Normal Early	Mod. high retention	Varies
Carcinoma { Ampulla... Pancreas..	Complete o	High	1. Direct	Negative	Normal	Low retention	Faint
	Partial +		2. Biphasic	Early	Early	Iso-iodoikon	Enlarged

of fever, an indeterminate blood count, either a palpable liver or one disappearing at the costal margin, and, just plain jaundice, of greater or lesser duration. What to do?

Fortunately, we are dealing with a situation in which there is no hurry. Very few biliary disorders, and only an occasional gall-bladder development require emergency surgery. Time gained here is usually all in favor of the patient, and to the delight of the medical man he can assemble his exhibits in an orderly manner. Naturally we must differentiate here among acute, diffuse disorders of the liver (such as necrosis, yellow atrophy, or toxic cirrhosis), which are *non-surgical conditions*; carcinoma of the ampulla or pancreatic head, and similar *borderline surgical conditions*; and stones in the extra-hepatic ducts, an *absolute surgical condition*.

The history and physical examination may not be particularly enlightening unless a cystic tumor is felt in the right upper quadrant, which we feel to be a distended gall-bladder. In such a case the likelihood that we may be dealing with a carcinoma

hepatic block, which may require surgical relief.

Many physicians consider cholecystography contraindicated and even dangerous in jaundice. It is, of course, likely to be valueless, because the dye generally cannot reach the gall-bladder. However, undoubtedly in borderline cases, a combined visualization and functional liver test by the use of Graham's iso-iodoikon intravenously, has been of great value in demonstrating the size of the gall-bladder and whether or not it is functioning.

Foote's procedure of giving fractional doses of iodoikon in 1,000 c.c. of glucose solution on three consecutive days; eighteen hours after the last injection x-raying the gall-bladder region; and repeating this in forty-eight hours, often aids in distinguishing intrahepatic jaundice from common duct block.

A summary of the findings of the liver function tests in the various diseases to be differentiated is shown in the chart above.

By carefully analyzing and weighing the results of such procedures, a fairly

reliable diagnosis can be made. Diffuse disorders of the liver should be treated medically; stones and strictures of the extrahepatic ducts surgically. Carcinoma usually invites surgical exploration in the hope that an operable tumor of the ampulla may be found or that an immediate cholecystogastrostomy, duodenostomy or cholecystojejunostomy may relieve the jaundice and ameliorate distressing symptoms.

In general, however, gall-bladder disease presents itself as a problem in solving dyspepsia or attacks of colicky pain or both, or as an acute abdominal situation which may or may not require emergency surgery. It should be recognized that usually the disease is very chronic and frequently unsuspected. Therefore, the careful diagnostic study I have indicated above should be made. Critical clinical study of the results is essential. X-ray films and the laboratory will frequently confirm and occasionally make the diagnosis; but they cannot size up the case or advise the patient. This must be done with consideration of the individual from all angles. Simply because gallstones are demonstrated or the gall-bladder cannot be visualized, it does not follow *a priori* that gall-bladder disease is the cause of the complaint.

Such clinical study will make less frequent the error of removing the gall-bladder in attempting to cure a condition actually due to mucous colitis, spastic constipation or irritable colon; nervous exhaustion; functional dyspepsias associated with any or all of these; renal calculi or pyelitis or ureteral angulation or stricture; the root pains of arthritis and other forms of radiculitis; tabes, migraine, appendicitis and pelvic pathology; and even duodenal ulcer (although I believe if there is actual disease of the gall-bladder associated with peptic ulcer, the gall-bladder should be removed). The first essential is to determine that it is the gall-bladder that is kicking up the row. If we can be certain of this and can demonstrate stones, or if we suspect fibrous thickening of the wall, or have the history

and clinical evidence of recurring colic or icterus, then, no contraindications existing, I believe surgical removal of the gall-bladder is indicated. And, in all fairness, I must admit that occasionally such a procedure cures an apparently functional colon disorder. Of this I have just had two examples, one in a woman and the other in a man, both of whom had been petting their colons for years, until sudden and recurring colics led to demonstration of stones in the gall-bladder. Since cholecystectomy, the colon has ceased to be a concern, and there is increasing ability to handle a general mixed diet.

I think we all agree that in the very definite, very severe lesions of the gall-bladder, suppuration, gangrene, perforation, multiple or single large stones; definite cholecystitis with change in the wall; abnormal visualization with faint shadow and evidence of persistent loss of function, especially if the latter is associated with colic; intermittent febrile attacks and/or icterus, surgery is the only procedure to consider. It has also been demonstrated that the more severe the symptoms, the more definite the diagnosis, and the more obvious the surgical need, the better are the results obtained.

#### ACUTE SITUATIONS

In all of the lesions enumerated above, severe acute attacks may develop with block in the cystic or common duct, a tender cystic tumor, fever, chills, sweats, leucocytosis and all the other features of an acute cholecystitis with suppuration, imminence of perforation and likelihood of gangrene. Is this a surgical emergency requiring immediate operation, or dare we wait, convinced if we can tide the patient over this crisis there will be less danger from the complicating hepatitis, a less dangerous and stormy convalescence and a lower mortality rate? In the University of California Hospital we wait, and so successfully has this been accomplished with several of my patients, in whom I believed the direst consequences were cer-

tain, that I fully concur in the procedure. On the other side of the picture, one experience with a "red hot" gall-bladder, which we regarded as a surgical emergency, afforded me a liberal education.

Wilkie says it is seldom necessary to operate during the acute stage of cholecystitis, but if after forty-eight hours there is no evidence of the subsiding of the inflammation, it is better to operate without further delay. Graham agrees, but would wait until the acute symptoms have subsided. He further states that he has never seen a perforation into the free peritoneal cavity, but when perforation has occurred, a localized abscess has been present adjacent to the gall-bladder, or the perforation has occurred into the intestine. More patients are saved by postponing the operation; postponement is safer in the relatively young on account of the better blood supply of the gall-bladder, than in an old subject, where there is greater danger of necrosis of the wall. Tom Brown believes it is best to have no fixed general rules, not to apply any dictum too rigidly, but by a careful observance of the clinical features, to determine after an interval, whether there is subsidence or progression, and to operate if there is progression. In some cases, however, suppuration and gangrene may develop with very few or no local, general or laboratory findings. Mentzer believes that what may appear to be a mild cholecystitis may actually be fulminant. The tendency at the San Francisco Hospital has been to operate early.

#### ESSENTIALLY MEDICAL CASES OF GALL-BLADDER DISEASE

So far, this exposition of mine has been largely in favor of surgery. I think most of us agree that the indications for operation in biliary diseases are: (1) to relieve local symptoms such as biliary colic, dyspepsia and definite cholecystitis; (2) to combat distant toxic effects; and (3) to anticipate the onset of malignancy. In addition, certain cases of angina, pseudo-angina and even myocardial disease have been relieved,

as has arthritis by gall-bladder operations. On the other hand, there are many unfavorable sequelae, such as post-operative adhesions, a common duct stone pushed down at operation, functional disturbances that remain after gall-bladder removal, the reactions on an unstable psyche, biliary tract disease primarily established before the gall-bladder became involved, secondary dilatation of bile radicles, destruction of the functional ability of Oddi's sphincter, increased intestinal putrefaction and fermentation, and, last but not least, mistaken diagnoses.

Unless the operative indications are very certain; if the symptomatology is blurred and indefinite; or if we *have laid our diagnosis* more on the altar of cholecystography—it is wiser to postpone the operation indefinitely, until a ripened clinical judgment bids us proceed after a sufficient medical therapeutic test. Cases that seem suitable for this medical trial tend to fall into definite groups, of which I have listed four:

1. There is the middle aged or old person in whom a stone or stones are discovered on films taken in a routine survey, in whom we believe the gall-bladder is well contracted down, and in whom the symptoms are not active or are over-shadowed by other conditions.

2. There is the younger individual in the fourth or fifth decade in whom a good normal functioning gall-bladder is indicated by cholecystography, with one or several small stones, but without definite or disturbing symptoms. (I may say here, in parenthesis, however, that in my opinion the younger the individual with cholelithiasis the more likely the necessity of ultimate removal.)

3. Then there is that much larger group of individuals with symptoms of varying degree, suggestive or clearly referable to the gall-bladder, in whom the cholecystographic shadow is interpreted as normal or nearly normal, and in whom we make the diagnosis of cholecystitis without stones, or, as designated by Graham, the

stoneless gall-bladder. Of course, in many such cases there are stones not visualized.

Many writers have called attention to the frequency of unsatisfactory results after cholecystectomy where gall-bladders showed a minimal change from normal. This holds true even if the diagnosis of cholecystitis is correct, which it often is not. Only after eliminating pathologic conditions in all the neighborhood organs, including the spine, should surgery be considered. Intermittent colic, especially due to a stone in the cystic duct or neck of the gall-bladder, affords the most certain indication. If the symptoms are mild, no matter what the extent of the pathologic changes, the results of surgery may be very poor.

After operation on 161 such cases, Graham found that only 60 per cent considered themselves well; however, 76 per cent of those who had had colic were well. The mortality was high in this group, probably because they had general constitutional disorders, of which the suspected gall-bladder disease was only an insignificant detail. There seems, therefore, little justification for the subjection to operation of patients who have only the early beginnings of cholecystic disease, and results will be far from satisfactory in about one-half of the cases. Many of these patients are on the borderline between purely functional disorders and anatomic disorders that produce disturbances of function. If the gall-bladder functions, let us see what can be done with medical treatment.

4. A fourth group would include, theoretically, the so-called functional disorders of the gall-bladder, or biliary dyskinesias. It has been suggested that biliary distress without gallstones or inflammation may result from a motor dysfunction of the extrahepatic passages. This is related to the reciprocal contraction of the gall-bladder and the simultaneous relaxation of the sphincter of Oddi. Ivy and his students demonstrated that the presence of acid or of fatty substances (cream, egg

yolk, olive oil and oleic acid) in the duodenum and upper intestine, caused the formation of a hormone (cholecystokinin) which stimulates contraction of the gall-bladder. At times there develops a spastic obstruction of the sphincter of Oddi, and when fats cause a contraction of the gall-bladder, pain and colic may result. Magnesium sulphate in the duodenum will relieve the pain. Atropine, magnesium sulphate, magnesium oxide and sodium sulphate favor the flow of bile. Ivy also advises a fat intake to suit the tolerance of the patient. It is an interesting conception, but the practical therapeutic procedures are not entirely determined.

#### MEDICAL TREATMENT OF GALL-BLADDER DISEASE

This brings us to the point where the surgeon may be willing to find out what the medical man can do about the situation, taking it for granted that the gall-bladder really is at fault. Possibly, this inclination may be influenced by a desire to preserve his mortality records, or his end results. What, if any, is the medical treatment of gall-bladder disease?

Formerly, it consisted of a fat-free diet, without consideration of whether the gall-bladder was functioning or jaundice was present—a diet without cellulose or other roughage and with no particular reference to the intake of carbohydrates, but emphasizing frequent feedings. In addition, there was the regular morning saline (Sodium phosphate, magnesium sulphate, or Carlsbad sprudel salts); the nightly liver pill with mercury (especially calomel) or podophyllin; usually a biliary disinfectant, such as sodium benzoate, sodium salicylate, urotropin, methenamine (Hurst) or the like; and whole ox bile. Also, according to the gastric analysis, hydrochloric acid or alkalis were used symptomatically. In the plethoric and obese this procedure was generally successful at first, but ultimately led to colitis, intestinal fermentation and additional misery. In the thin and asthenic patient it played hob, leading to loss of

weight, malnutrition and a loudly complaining gastrointestinal tract.

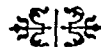
Today, we have given up biliary disinfectants pretty much; still use hydrochloric acid or alkalis according to the functional needs and frequently include pancreatic extract. We have added antispasmodics as required. We critically judge the effects of salines and laxatives in their reaction on the colon (possibly substituting lubricants and agar jelly); and determine the need of whole bile and bile acids by the gall-bladder response and whether or not sufficient bile is reaching the intestine. Catharsis, as a uniform procedure, is more or less taboo. In other words, we adapt our treatment to the gastrointestinal needs of the individual.

The big change has come in our dietary directions and in our conception of how we may stimulate or protect the gall-bladder and improve the condition of the liver. Roughage and cellulose still are prohibited; purées and soft pulp are given as needed. Carbohydrates are called on extensively, the only restrictions being for obesity and intestinal fermentation. Our use of fats has materially changed. In general, the concepts expressed by Dr. Tom Brown above are accepted and we do not fear the intake of lipoids, of themselves, as the essential factors of gallstone formation. If we have a gall-bladder which will function, as indicated by cholecystography, the judicious use of olive oil, butter, cream and egg yolk as a prophylactic measure of insuring this functional activity is indi-

cated. Of course, in any dyspepsia, cooked fats, such as fries, pastries, gravies and the like, cannot be handled; and we object to rich foods and over-feeding generally. Individualization in diet is required and it must be plain and simple. We should, if possible, keep the patient at his ideal weight. If we presume the gall-bladder to be atonic, fat will favor evacuation; if it is irritable the fat intake will have to be adjusted to the tolerance of the patient. With a non-functioning gall-bladder, or in the presence of biliary or pancreatic insufficiency, fats may need to be eliminated. There has been also a common prescription of frequent feedings to increase the flow of bile. I do not believe this to be correct, unless there is an associated duodenitis or peptic ulcer. I incline to the dictum of Whitaker: allow the patient to get hungry; do not over-feed; and space the fat stimulation to the gall-bladder in order not to exhaust its activity. Ivy believes that, besides fats, meat and *acid fruit juices* excite gall-bladder activity. He would not eliminate them entirely, but adjust their use and amount to the tolerance of the patient.

Such procedures very frequently control the digestive disturbances that are mainly distressing the patient, and if combined with the therapeutic control of the related colon disorder, may entirely abolish abdominal discomfort.

It is quite possible that they may also act prophylactically in arresting or curing gall-bladder disease not too far advanced.



# THE EARLY SURGICAL TREATMENT OF ACUTE CHOLECYSTITIS\*

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THE surgical treatment of acute cholecystitis has frequently been discussed in recent literature; and it is evident that there exists a difference of opinion as to the advisability of early or delayed operation. The purpose of this paper is to present our experience with early surgical treatment of acute cholecystitis—an experience which now comprises 170 consecutive cases treated in the early stages of the disease at the New York Hospital in the past five years.

Rather than attempt a definition of "acute cholecystitis" I prefer to enumerate the clinical and pathologic findings which have justified the diagnosis. A review of the 170 cases is followed by a brief description of the operative methods employed and a discussion of some of the controversial questions in the treatment of acute cholecystitis.

The clinical diagnosis of acute cholecystitis has been based upon a careful evaluation of the history given by the patient, of the symptoms, and of the signs elicited by physical examination. In the typical case a fairly long history of recurring episodes of gallstone colic frequently precedes the onset of the acute attack; there may, however, be no record of previous symptoms referable to the biliary tract. The pain is severe, located in the right upper quadrant of the abdomen and often radiates to the back or shoulder. Nausea and vomiting frequently accompany the onset of pain. The physical examination reveals marked tenderness in the right upper quadrant, associated sometimes with muscular rigidity in this area. The gall-bladder may be palpable as a distended and tender mass. The patient looks ill, has a rapid pulse, some fever and

an elevated leucocyte count. Many patients whose attacks have lasted more than twenty-four hours show a mild degree of jaundice. A considerable number of the 170 patients failed to present the characteristic manifestations of acute cholecystitis. In some there was no fever; in others the leucocyte count was normal, and in still others the symptoms were not acute and, therefore, gave little hint of the seriousness of the inflammatory process. In these atypical cases the final differential diagnosis was made on the basis of the findings at operation and the pathologist's report.

At the operating table the surgeon finds a reddened, distended gall-bladder with thick, edematous walls. Besides one or more stones, the organ usually contains colorless bile or pus under pressure. On close inspection, areas of necrosis and gangrene of the wall may be noted, and in some cases a frank perforation will be found with inflammatory reaction around the gall-bladder and adhesions between it and neighboring structures. Free perforation with general peritonitis also may occur. On gross pathologic examination, an acutely inflamed viscus with congested and edematous walls and areas of necrosis is described; microscopically, the specimen shows polymorphonuclear infiltration with desquamation of the epithelium and necrosis of one or all layers of the gall-bladder.

All of the 170 cases reported in this series fulfilled the above clinical and pathologic criteria for a diagnosis of acute cholecystitis.

## REVIEW OF CASES OF ACUTE CHOLECYSTITIS

Over a period of five years, 170 cases of acute cholecystitis have been treated surgically at the New York Hospital. A

\* From the Department of Surgery of the New York Hospital and Cornell Medical College.

series of charts are introduced to show the important data concerning these cases. Each chart is designed to illustrate one aspect of the study.

Chart I shows certain important findings on admission and the operative mortality for the entire group of cases. It will be seen that the average age was 46 years; the average duration of symptoms before admission two and one-half years; the

CHART I

170 CONSECUTIVE CASES OF ACUTE CHOLECYSTITIS  
Treated Surgically from September 1, 1932 to  
September 1, 1937

Average age..... 46 years  
Average duration of symptoms..... 2½ years  
\*Average temperature elevation on admission..... .43°C  
Average W.B.C. on admission..... 12,086  
Mortality rate for entire group..... 3.5 per cent  
\* Normal temperature 37°C.

average elevation of temperature .43°C. above normal; the average leucocyte count 12,086; and the mortality rate 3.5 per cent. It may be said in regard to the duration of symptoms before admission that the average of two and one-half years probably is an understatement; few patients remember clearly the onset of vague symptoms of biliary tract disease.

Chart II gives a classification of the 170 cases according to the extent and severity of the inflammatory process in the gall-bladder and the average leucocyte count,

CHART II

170 CASES OF ACUTE CHOLECYSTITIS

Diagnosis	No.	Deaths	Mortality Rate, Per Cent	Average W.B.C.	Average Age
Acute cholecystitis.....	117	3	2.56	11,587	43
Acute cholecystitis with gangrene.....	38	1	2.6	12,883	47
Acute cholecystitis with gangrene and perforation.....	15	2	13.3	15,003	48

the average age and the mortality for the patients thus classified. It is interesting to note that leucocyte count and mortality increase with the extension of the inflammation; that after perforation the mortality is very high and that the majority of

patients with perforation were in the older age group (50 or more years of age).

Chart III shows the relationship of the operative mortality to the duration of symptoms before admission. It is apparent that the longer gallstone disease is allowed to persist without surgical intervention, the graver the risk of operation when an acute attack occurs. In sixty-nine patients

CHART III

DURATION OF DISEASE AND MORTALITY RATE

Duration	No.	Deaths	Per Cent Mortality
Under 1 month (12 with initial attacks).....	41	0	0
1-6 months.....	17	0	0
6 months-1 year.....	11	0	0
1-5 years.....	56	2	3.5
5-10 years.....	20	2	10
10-20 years.....	20	2	10
20 years and over.....	5	0	0

Age Incidence and Mortality Rate

	Cases	Per Cent Mortality
Under 50 years of age.....	116	1.7
Over 50 years of age.....	54	7.4

with symptoms for less than one year, no post-operative death occurred; in 101 patients with manifestations of gall-bladder disease for longer than one year there were six deaths. Age, also, is shown to have a bearing on the outcome of operation.

Chart IV refers to 117 cases with acute cholecystitis but without gangrene and perforation. In this group again, the duration of symptoms before operation and the age of the patient have an effect upon the outcome of surgery. The figures are not significant because the total number of deaths was small.

Chart V records the duration of the disease and mortality rate in fifty-three



cases of acute cholecystitis with gangrene. All patients whose symptoms had endured for less than five years survived operation. With a history of more than five years of

CHART IV

117 CASES OF ACUTE CHOLECYSTITIS WITHOUT GANGRENE  
Mortality Rate 2.5 Per Cent

Duration	No.	Deaths	Per Cent Mortality
Duration of Disease and Mortality Rate			
Under 1 month (including first attack).....	29	0	0
1-6 months.....	11	0	0
6 months-1 year.....	9	0	0
1-5 years.....	43	2	4.6
5-10 years.....	9	0	0
10-20 years.....	13	1	7.6
20 years and over.....	3	0	0

Age Incidence and Mortality Rate

	Cases	Per Cent Mortality
Under 50 years of age.....	87	2.3
Over 50 years of age.....	80	3.3

gall-bladder disease, the mortality after operation was 15 per cent. The age incidence seemed of less importance in this group of cases.

Chart VI has been introduced to show the incidence of acute cholecystitis in the total 732 cases of non-cancerous gall-bladder disease treated at the New York Hospital in the five year period. It also shows the mortality for the total number and for the groups of cases with chronic and acute cholecystitis. It is interesting to note that there is no significant difference in the mortality rate in the three groups of cases, but a marked increase in the number of deaths is shown in all patients over 50 years of age.

In summarizing the information given in the charts it may be said that two

factors, besides the extent of the inflammatory process, have a definite bearing

CHART V

53 CASES OF ACUTE CHOLECYSTITIS WITH GANGRENE  
Mortality Rate 5.6 Per Cent

Duration	No.	Deaths	Per Cent Mortality
Duration of Disease and Mortality Rate			
Under 1 month (including first attack).....	12	0	0
1-6 months.....	6	0	0
6 months-1 year.....	2	0	0
1-5 years.....	13	0	0
5-10 years.....	11	1	9.0
10-20 years.....	7	2	28.0
20 years and over.....	2	0	0

Age Incidence and Mortality Rate

	Cases	Per Cent Mortality
Under 50 years of age.....	29	7.0
Over 50 years of age.....	24	4.1

CHART VI

PATIENTS WITH NON-MALIGNANT DISEASE OF THE  
GALL-BLADDER AND BILIARY TRACT TREATED  
SURGICALLY—SEPTEMBER 1, 1932 TO  
SEPTEMBER 1, 1937  
Mortality Rate

	Per Cent Mortality
All patients	
732 total.....	3.5
594 less than 50.....	1.8
138 50 or over.....	10.8
Chronic disease of the gall-bladder and biliary tract	
532 total.....	3.6
478 less than 50.....	1.9
84 50 or over.....	13.0
Acute cholecystitis	
170 total.....	3.5
116 less than 50.....	1.70
54 50 or over.....	7.4

on the outcome of operation in acute cholecystitis. The first of these is the duration of symptoms referable to the gall-bladder before the onset of the acute attack for which surgical treatment is undertaken, while the second is the age of

the patient at the time of operation. These findings apply more directly to the treatment of chronic gallstone disease than to the early treatment in acute cholecystitis. As regards this question, it can be stated that in this series of cases the mortality after early operation was not high in cases of uncomplicated acute inflammation, but that gangrene and perforation added seriously to the danger of a fatal outcome. There is no positive indication in the individual case as to whether the inflammation will subside or spread. To be sure, the average leucocyte count is higher in acute cholecystitis with gangrene than it is before gangrene has developed, and again higher in cases with gangrene and perforation. In the individual case, however, this distinction is not apparent, nor is it helpful in determining the extent of the pathologic process.

#### OPERATIVE PROCEDURES

In acute cholecystitis, cholecystectomy is the operation of choice, for the removal of the gall-bladder interrupts the pathologic process, and averts the danger of gangrene or gangrene and perforation. The contraindications to this radical operation in acute cholecystitis are: (1) The presence of peritonitis due to perforation of the gall-bladder. In this situation an extensive operation is contraindicated because of the gravity of the patient's condition. (2) Conditions which make it difficult to identify the important structures in the right upper abdomen. When the gall-bladder is greatly distended and adherent the adjacent viscera may be so distorted that anatomic relationships are obscured. In an attempt to free the gall-bladder from neighboring structures, there is the danger of inadvertently injuring the common duct or the hepatic artery. (3) The presence of jaundice caused by obstruction of the common duct makes an extensive operation hazardous. It usually is better to drain the gall-bladder in the hope that the acute inflammation will subside and the jaundice disappear, than to remove the stone in the

common duct which is obstructing the flow of bile. When jaundice and acute infection have subsided, cholecystectomy and choledochotomy can be undertaken with less hazard. (4) A situation in which the general condition of the patient is so grave that a general anesthetic and prolonged operation are not justified. This state of affairs is likely to arise when acute cholecystitis is superimposed upon systemic disorders such as hypertension, cardiovascular or renal disease. It is known that such patients are particularly subject to the complications of acute gall-bladder infections if the process is allowed to persist. A compromise must be sought in the form of surgical treatment which adds the least burden to the patient.

On the basis of the principles enumerated, 131 of the 170 cases of acute cholecystitis were treated by cholecystectomy and 14 by cholecystostomy; in 15 cases the common duct was opened and explored for stones.

*Cholecystostomy.* The peritoneal cavity is approached through a short upper right rectus incision which can be enlarged if it proves inadequate for good exposure. After careful inspection of the biliary tract, a purse-string suture is placed in the fundus of the gall-bladder and a trocar introduced to aspirate the fluid contents. Semisolid material and stones are removed through an incision in the fundus and a search made for stones impacted at the ampulla. Following this procedure, a soft rubber tube is placed in the gall-bladder, anchored to the fundus, and the fundus in turn is secured to the peritoneum by means of a series of interrupted sutures. If an extra-cholecystic abscess has been opened, a cigarette drain is inserted into the abscess cavity and brought to the surface of the abdomen with the tube in the gall-bladder. The closure is carried out in any manner the operator prefers. A silver wire through-and-through closure is recommended for these cases, especially in the presence of jaundice. This closure can be completed in a short time and it offers protection against disruption of the wound. Bile plus

infection tends to weaken a closure with catgut.

**Cholecystectomy.** If, after inspection of the upper abdomen, and evaluation of the findings, the surgeon decides to remove the gall-bladder, the incision must be lengthened so as to permit good exposure of the operative field. A hockey-stick prolongation up to the xiphoid usually will suffice. The omentum and viscera around the gall-bladder are freed and retracted away from the biliary fossa. If it is evident at this point in the procedure that the distention of the gall-bladder is going to interfere with visualization of the ducts and blood vessels, its contents may be aspirated before proceeding with the cholecystectomy. In preparation for this maneuver gauze pads are placed over the operative field, leaving exposed a small area of the fundus through which the trocar is inserted between purse-string sutures. After the contents have been withdrawn, the trocar is removed and the purse-string suture drawn tight and tied.

Returning to the cholecystectomy, one of two methods may be employed, depending upon the circumstances encountered and the surgeon's choice. The first of these is the more frequently used; in it the gall-bladder is removed from the ampulla towards the fundus. The first step is the division of the vessels and the cystic duct. This procedure must be carried out under direct vision, and therefore the peritoneum over the cystic duct is incised from the ampulla to the junction of the cystic and the common ducts. The vessels and the duct will come into view when the divided peritoneum is retracted. The artery and vein are freed, divided between right angle clamps and doubly ligated with a plain ligature and, distal to it, a transfixing ligature. The cystic duct, freed from its attachments, is secured with two right angle clamps and divided between them. The clamp on the end of the cystic duct which is attached to the gall-bladder is used as a retractor while the dissection goes forward. When the gall-bladder is acutely

inflamed, care is required to strip it from its bed without injuring the liver and other adjacent structures. To avoid this danger, the line of dissection should be kept as near the wall of the gall-bladder as possible. The bed from which the organ has been removed is packed with a wet gauze sponge while the cystic duct is transfixed with double sutures. The wound is now inspected for bleeding, the omentum is allowed to fall back into its original position over the viscera, which were retracted during the operation, and the wound is closed.

Another method of cholecystectomy, and sometimes the less difficult, is that in which the gall-bladder is removed from above downwards. An incision is made in the peritoneum over the gall-bladder at a point about 1 cm. from its junction with the liver. The fundus of the gall-bladder is grasped through the opening and held in a clamp while the dissection is carried down toward the ampulla. Careful hemostasis is essential during this procedure. When the dissection approaches the ampulla, the cystic artery and vein should be identified, clamped, divided and ligated separately. The peritoneum over the cystic duct is incised and retracted from the ampulla to the junction with the common duct. Under direct vision the duct is secured with two right angle clamps and divided between them. The remainder of the procedure is as described above.

Should the gall-bladder be found adherent to the duodenum or large bowel, or firmly attached to the liver, it may not be advisable to attempt to remove it intact. Instead, a small segment may be left and its mucosa destroyed with the cautery.

The exploration of the common duct has been described in detail by the author in another text.

#### DISCUSSION

On the basis of the careful study which was made of the 170 cases of acute cholecystitis treated in the early stages of the attack, a few of the current controversial questions may be discussed.

One question which frequently is voiced in the literature is whether all cases reported in a given series were actual examples of acute cholecystitis. There is little doubt that there are in the literature reports of cases which would not, in the opinion of a discriminating observer, meet the criteria for acute inflammation. The basis for the diagnosis of acute cholecystitis in this group of cases has been given.

An argument which has been used in defense of delay in operative treatment is, that an operation upon an acutely inflamed gall-bladder is more difficult and therefore more hazardous than one in which the acute inflammation has subsided. A grave hazard in immediate operation is not demonstrated in the study of the group of cases reported. The mortality for the entire series of cases, irrespective of pathology, age and other important factors, is 3.5 per cent. It may be interesting to note that the surgery in the 170 cases has been performed not by one, but by ten or more general surgeons. The real difficulties in operating are encountered in cases which are allowed to proceed to gangrene and perforation, or which subside, leaving the patient with an extracholecystic abscess or masses of adhesions.

Another question on the treatment of acute cholecystitis to which reference is made, is whether the removal of an acutely inflamed gall-bladder is not attended by an extension of the infection. It is true that streptococcic infection of the biliary tract is not uncommon and that streptococcic infection tends to spread when disturbed by operation. However, experience here and in many other institutions proves that

fulminating streptococcus infections after cholecystectomy rarely occur. Furthermore, it has been demonstrated that contamination of the operative field with contents of an acutely inflamed gall-bladder does not result in an extensive peritonitis. When an extracholecystic abscess or peritonitis is present, the danger of spreading the infection must be borne in mind.

As to the question of complications after operation, there is nothing to indicate that these are influenced by the time at which operation is performed. Much more significant in this respect is the age of the patient and his general condition before operation. If time is taken to counteract such conditions as dehydration, cardiac decompensation, etc., and the operation is planned so that it places little additional burden on a sick patient, the incidence of complications after operation in the acute stage is, in our experience, no higher than after cholecystectomy in chronic cholecystitis.

#### SUMMARY

A series of 170 consecutive cases of acute cholecystitis treated by early operation at the New York Hospital in a five year period is reviewed.

The criteria employed in diagnosing acute inflammatory disease of the gall-bladder are enumerated.

A brief description of the technique employed in cholecystostomy and cholecystectomy is presented.

Some of the current controversial questions in regard to the treatment of acute cholecystitis are discussed.



# THE TREATMENT OF ACUTE CHOLECYSTITIS\*

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IN recent years there has been a swing in surgical opinion toward earlier intervention in acute cholecystitis.

Five years ago the writer<sup>1</sup> analyzed a series of 201 patients who came to operation at St. Luke's Hospital for this condition, in an endeavor to clarify his ideas on the subject. The mortality of the series was 7.3 per cent. Dividing them into two groups on the basis of whether the disease was still active or had subsided at the time of operation, we found the mortality of the former group was 9.3 per cent and of the latter 5.3 per cent. Recently these histories have been reviewed, private and unoperated cases as well as some previously overlooked included, and the series brought up to date, making a total of 436 cases over a seventeen year period. Of these, 356 were operated upon with a mortality of 8.4 per cent. Of the eighty unoperated cases 6.3 per cent died.

*Definition.* It has seemed to the writer that any case which presents clinically presumptive evidence of an acute attack should be included. The story of pain and the finding of localized tenderness over the gall-bladder are essentials to the diagnosis. The absence of fever and leucocytosis, indicating a mild or waning attack, have not been grounds for exclusion unless operative findings failed. Grossly most gall-bladders in patients who have been allowed to wait for operation for a number of days after the fever has subsided are still acutely inflamed in appearance. The microscopic diagnosis represents a criterion which is of great value, but if every case in which the pathologic report did not define the cholecystitis as acute were thrown out, some patients who obviously should be included would be eliminated.

In order to see whether too broad an interpretation had been followed, the group in which a microscopic diagnosis of acute cholecystitis was found, together with those in whom drainage only was done (obviously the severer cases), were combined, making a series of 238 with an 8.8 per cent mortality, compared with the whole series of operated cases in which the mortality was 8.4 per cent. This difference does not seem significant.

*Pathology.* Calculi are rarely lacking. In the acute case drainage is so often blocked by a stone occluding either the cystic duct or the neck of the gall-bladder as to make it seem the common cause of the attack. Empyema, gangrene and perforation are eventualities occurring in slightly less than one third of the St. Luke's series. So far the analogy to appendicitis is impressive; unlike appendicitis, however, perforation into the general peritoneal cavity is unusual. In the Roosevelt Hospital series,<sup>2</sup> general peritonitis was found in seven of 300 cases. In the present study of 356 operative cases, four had a spreading peritonitis and in three or four others (in one case the record is questionable) there was bile in the peritoneal cavity. Perhaps a lesser average virulence in the type of biliary infection, as well as the anatomic location, plays a part in localizing the consequences of gall-bladder disease more often than in appendicitis.

*Treatment.* Before proceeding to the more detailed discussion of treatment I would like to present some figures and opinions on matters important to it, namely: (1) the rising incidence of serious pathologic conditions; (2) spontaneous subsidence; (3) the risks of early as opposed to late operation.

\* From St. Luke's Hospital New York City.

The incidence of empyema, gangrene and perforation increases as attacks are prolonged. In the St. Luke's Hospital series there is a sharp peak in those coming to operation after forty-eight hours. For the first week the percentage is 27, for the second 31 and thereafter 53. To avoid these more serious pathologic conditions is one of the purposes of early intervention, as is the case in appendicitis.

There is a general impression that an attack of acute cholecystitis, if treated expectantly, will subside in the large majority of cases. Zininger,<sup>3</sup> however, in fifty-four patients observed for periods of twenty-four hours to twelve days, found that less than two-fifths showed improvement while the remainder failed to improve or got worse. In the St. Luke's series I have estimated progress in 184 patients in the active phase of the attack, as judged mainly by a temperature of 100°F. or more, including both operative and non-operative cases who were observed for two days or longer before operation or discharge. In this group a little more than two-thirds subsided or were improving, the remainder failed to improve or grew worse. It is true, however, that not a few patients whose temperature has become normal still have a serious pathologic condition which is likely to result in an exacerbation of symptoms.

The nub of the question of when to operate is that of the risk of immediate surgery versus the risk of delay.

Heuer<sup>4</sup> believes in early operation and from his service at New York Hospital has reported a series of 153 cases with a 3.2 per cent mortality, a lower rate than any of those who differ with him have shown, as far as I am aware. Sixty-five per cent of these patients were operated upon on the day of admission.

H. F. Graham<sup>5</sup> reported a series of 198 cases from the Methodist Episcopal Hospital in Brooklyn; of these twenty were operated upon within forty-eight hours with a 5 per cent mortality. Among the remainder the mortality was 6.2 per cent and complications much more numerous.

McKenty<sup>6</sup> thinks that operation in the first forty-eight hours has a mortality low enough to justify it as a routine measure. Of ninety-eight cases reported by him those who came to operation in the first three days had a mortality of 4 per cent; from the fourth to the tenth day, 9 per cent; and after the tenth day 12 per cent.

Mentzer<sup>7</sup> is an advocate of early operation and states that since he has become bolder in this regard his results have improved.

Miller,<sup>8</sup> stimulated by the occurrence of perforation in two patients who were being allowed to cool off, studied the Massachusetts General Hospital material and found that in the fatal cases the average duration from the onset of the attack to operation was fifteen days while in those who recovered the average time was eight days. He felt that the expectant plan of treatment should be promptly abandoned if the patient was not definitely improving.

Branch and Zollinger<sup>9</sup> reviewed the Peter Bent Brigham Hospital material in a paper which they designated as a study of conservative treatment. Thirty-four of their series of 229 operative cases were submitted to immediate surgery with a mortality of 14.4 per cent as opposed to the general mortality of 10.4 per cent.

Pennoyer,<sup>2</sup> in a recent paper read before the New York Surgical Society, presented a study of 300 cases from the Roosevelt Hospital, where the surgeons prefer to allow the attack to subside before operating. In order to leave no doubt as to the acuteness of the attack, he included only patients who had had a temperature of at least 101°F. and a leucocytosis of 12,000 or more. The general mortality was 10 per cent. In the fifty-nine cases operated on as emergencies the mortality was 25 per cent, representing half the fatalities in the whole series. In about one-half of the emergency cases some other acute abdominal condition was suspected.

It is but fair to emphasize that in both Branch and Zollinger's and in Pennoyer's series only the seemingly urgent cases were

operated upon immediately, nor were these necessarily early cases reckoning from the onset of the attack.

R. R. Graham<sup>10</sup> of Toronto champions a conservative attitude. It is his practice to withhold operation until the temperature is normal unless the condition is becoming worse. He reported 5.8 per cent mortality in sixty-eight operated cases.

In the St. Luke's Hospital series, 127 patients were operated upon in the first twenty-four hours after admission, with a mortality of 13 per cent. In the remainder the death rate was 6 per cent. If the cases are tabulated according to the day of operation from the beginning of the attack we have the following figures:

	No. of Cases	Per Cent Mortality
After two days of illness.....	39	10
Three to seven days.....	141	7
Second week.....	99	9
Third week and after.....	58	10

We may at least conclude that fulminating cases contribute to a high early mortality and cases depleted by long illness and advanced pathologic changes to a rising late mortality.

After subsidence of the clinical symptoms there is less risk than when intervention is carried out during the acute phase. Of 164 operated on while still febrile, the mortality was 12 per cent, as opposed to 5.2 per cent in the 192 who were afebrile. In the Roosevelt series the death rate in 208 subsided cases was only 2.5 per cent. It is manifest that if all patients with acute cholecystitis could be counted on to subside clinically there would be no difference of opinion as to the procedure.

*Discussion.* It seems plain from the foregoing that the question of immediate versus delayed intervention cannot be settled as yet by the statistical method. In the mean time it is the opinion of the writer that no rule of thumb can be laid

down and that each case must be judged on its own merits. There are three factors in acute cholecystitis which set it apart from appendicitis. In the first place patients with the former disease are as a rule in an older age group, many of them elderly. In the St. Luke's series one-half of the fatalities occurred in individuals of sixty or more, only two were under forty-five. In the second place, the operation of cholecystectomy, involving an upper abdominal incision and likely to be attended in acute cases with considerable bleeding, is a far more formidable procedure than appendectomy through an intermuscular incision. Finally, as has been already mentioned in the discussion of pathology, a spreading or generalized peritonitis is infrequent in acute cholecystitis as compared with appendicitis.

There always will be, of course, urgent cases which will require operation at once and contribute disproportionately to mortality. However, if a patient is seen early in the disease and is a good risk, particularly if his symptoms are not severe, a prompt cholecystectomy should not be attended with high mortality and forestalls the dangers of later complications.

In the severe acute case one will often have to be content with drainage only. This is an argument for a conservative policy, as an operation after cooling off offers a better prospect for cholecystectomy. On the other hand, as several writers have pointed out, the early acutely inflamed gall-bladder often lends itself to a technically easy removal on account of the edematous state in which the tissue planes are easily separated. The choice of procedure gives occasion for the most skilled judgment in the individual case.

In the average patient who is admitted with full blown, but not urgent, symptoms, particularly if she is middle aged or older, it is better to wait if possible for subsidence of the temperature. If, however, improvement is not reasonably prompt, one should intervene without undue delay unless the individual is a poor risk.

Cave<sup>11</sup> summarized his opinion in a paper before the American College of Surgeons in October 1937 as follows: "In the majority of these cases it is far better that these patients be observed for twenty-four or thirty-six hours or even longer, to see whether or not the temperature, pulse rate and blood count will diminish, indicating a subsidence of the inflammatory process. When the temperature remains elevated after thirty-six to forty-eight hours, the pulse rapid, and the general appearance is not improving, we do a cholecystectomy or cholecystostomy."

A patient whose management illustrates excellent judgment on the part of the surgeon was a woman of 71 who had been ill for six days and entered hospital with a temperature of 103 degrees and a blood count of 13,000 with 90 per cent polynuclears. She was observed for forty-eight hours during which time she ran a spiking temperature, accompanied by chills. At the end of this time operation was decided upon. She was found to have empyema of the gall-bladder which was removed. The post-operative course was uneventful with the temperature never approaching its pre-operative height.

How long is it wise to wait after subsidence of symptoms before intervention? The majority of surgeons, I believe, who prefer to allow the attack to cool off, favor operating within a few days to a week. At this time the organ usually still appears acutely inflamed and may present none too easy a technical problem. There is something to be said for postponing surgery for two or three months for an interval operation. The objection that many patients would fail to return is hardly a valid argument against the plan.

More worthy of consideration, however, is the fact amply demonstrated in the St. Luke's series and elsewhere that extravascular abscess, empyema and gangrene may be present in spite of a normal temperature and seeming improvement. That nature will eventually take care of some of these serious conditions I do not doubt, but

in some it will mean an early recurrence of symptoms and possibly less favorable opportunity for treatment. The writer has been impressed in going over the histories with the large number who had had previous attacks, not a few of them recent.

A case in point is that of a stout woman of 70 with many complaints who entered hospital with an acute attack of cholecystitis. She was considered a poor risk and after six days of normal temperature was discharged home. Within twenty-four hours she had a recurrence of symptoms and returned five days later. This time her gall-bladder was drained of a large collection of pus from which she made a good recovery.

Touroff<sup>12</sup> studied a series of seventy-five cases at Mt. Sinai Hospital with subsiding or subsided clinical manifestations at the time of operation. He found that 20 per cent of these had lesions that were considered progressive. The conclusion was that patients should be operated upon a short period of time after subsidence of symptoms has occurred.

#### CONCLUSIONS

The management of acute cholecystitis cannot be laid down by rule of thumb, but calls for individual judgment.

In general patients whose symptoms have subsided are better risks.

One should be prepared to intervene promptly if progress is unsatisfactory.

Caution is particularly indicated in older patients who furnish a large proportion of the fatalities.

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IN youth, second to tuberculous lymphadenitis, Hodgkin's disease is the most common cause of a chronic progressive lymph node enlargement. In about 65 per cent of the cases of Hodgkin's disease the first nodes to be involved are the cervical nodes. The disease is about twice as common in the male as in the female.

From—"Surgical Diseases of the Mouth and Jaws" by Earl Calvin Padgett (Saunders).

# ACUTE GANGRENOUS CHOLECYSTITIS AND THE USE OF PARTIAL CHOLECYSTECTOMY IN ITS TREATMENT

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**A**CUTE gangrenous cholecystitis has always proved a condition of considerable concern, inasmuch as its differentiation from the other types of acute gall-bladder disease is not invariably easy and its successful treatment depends upon the proper surgical procedure undertaken at the appropriate time. It is generally held to be an acute lesion superimposed upon previously existing gall-bladder disease which, if eradicated sufficiently promptly, might forestall the onset of this dangerous complication.

*Etiology and Pathology.* The marked thickening and edema of the gall-bladder wall followed by necrosis and gangrene result most commonly from a calculus impacted in the cystic duct or at the juncture of the gall-bladder ampulla with the cystic duct (Hoffman's pouch), which causes an occlusion or partial occlusion of the venous return from the viscus, leading to gangrene of its wall (Denton,<sup>3</sup> Andrews<sup>1</sup>). Infection in many cases is absent or plays quite a secondary rôle in the etiology. When active infection is present, empyema or acute suppuration supervenes.

Torsion of the gall-bladder may result in gangrene (Short and Paul,<sup>23</sup> Blank,<sup>2</sup> Murray,<sup>17</sup> D'Abreu<sup>4</sup>), but not typical gangrenous cholecystitis. Taylor<sup>26</sup> believes acute gangrenous cholecystitis is due to: (1) an acute gangrenous hemorrhagic infarct of the gall-bladder wall; or (2) an acute suppurative gangrene superimposed upon a vascular lesion, such as congestion, edema, hemorrhage, or an infarct. Steinke<sup>25</sup> states that cystic artery occlusion may be an etiologic factor. Gangrene may lead to perforation of the gall-bladder with a localized pericholecystic abscess or a general peritonitis; localized abscess is much more common.

The incidence of gangrenous cholecystitis in cases of acute cholecystitis and gall-bladder lesions in general has been variously reported. Taylor states that 2.07 per cent of 1,400 gall-bladder admissions were found to be gangrenous and 22.5 per cent of all acute gall-bladder lesions. In Heuer's<sup>12,13</sup> seventy-four cases of acute disease 25 per cent were gangrenous, and in Judd and Phillips'<sup>10</sup> series there was gangrene in 12 per cent of acute gall-bladder lesions. Zininger<sup>30</sup> reports fifteen instances of gangrene or empyema (17 per cent) in eighty-nine cases of acute cholecystitis; Mentzer<sup>18</sup> reports forty-three cases of perforation, gangrene, or empyema (32 per cent) in 134 acute gall-bladder lesions.

Perforation was found by Eliason and McLaughlin<sup>6</sup> in nine cases (1.8 per cent) of 490 gall-bladder admissions. Wyse's<sup>28</sup> figures show seven instances (1.5 per cent) in 463 admissions; D'Abreu,<sup>4</sup> three instances (2.6 per cent) in 116 consecutive gall-bladder operations; Fifield twenty-eight (2.6 per cent) in 1,066 operations; Sanders forty-six (5.2 per cent) in 886 operations; Niemeier three (.86 per cent) in 349 cases. Perforation may occur in gall-bladders that do not show gangrene.

Seventy-eight consecutive acute cholecystitis cases from our clinic, all verified at operation, have been classified as:

Acute non-suppurative.....	5
Acute suppurative without demonstrable gangrene.....	39
Gangrenous.....	34 (43.4 per cent)

Of the gangrenous group, twenty-four showed stones impacted in the cystic duct and ten gave a positive culture from the gall-bladder bile of either colon bacillus (nine) or staphylococcus Albus (one).

There were nine cases of perforation (11.5 per cent), seven with localized pericholecystic abscesses and two with acute general peritonitis.

and at times chills, with a marked upper right quadrant tenderness and muscular rigidity. Distention is usually present. There may be a mild jaundice and rapid

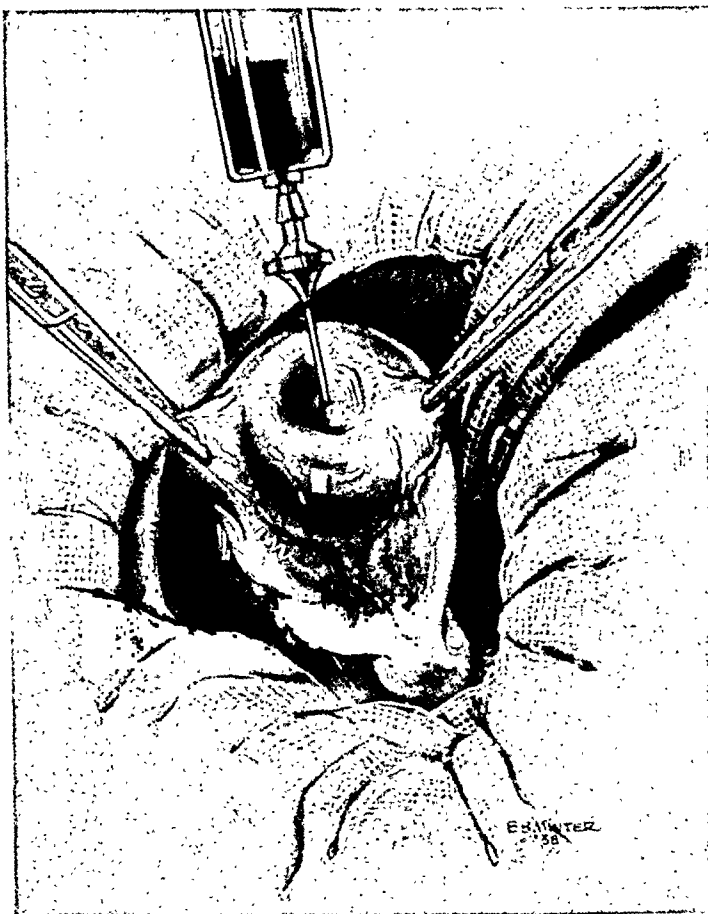


FIG. 1. Aspiration of gall-bladder.

The statistical incidence of gangrenous cholecystitis in acute cholecystitis varies according to whether clinical or operative criteria are used, and whether mild pathologic changes, such as simple edema of a portion of the gall-bladder, are included as evidence of acute disease. Acute gangrenous cholecystitis cannot be considered uncommon, since it will be found in approximately one-to two-fifths of all frankly acute cholecystitis cases.

*Symptomatology.* In the typical case there is an acute onset of upper right abdominal or mid-epigastric pain, very severe, that may radiate to the back or shoulder, accompanied by vomiting, fever,

pulse, and often great prostration. Within twenty-four to forty-eight hours the gall-bladder may be palpable as a tender mass protruding below the liver edge. Morphine will give temporary relief, but pain will recur, at times of equal intensity as that of onset or will become a constant severe ache or sense of pressure in the upper right abdomen. The leucocyte count is as a rule high—15,000 or over, with polymorphonuclears predominating. Unfortunately, the intensity and character of the symptoms are by no means uniform. There may be in twenty-four to forty-eight hours a remission of the acute symptoms, but the gall-bladder remains tender and palpable.

On the other hand, no definite remission may occur and the local pain and tenderness may increase or persist.

gangrenous cholecystitis from other types of acute gall-bladder disease is not only fraught with difficulty, but in many in-

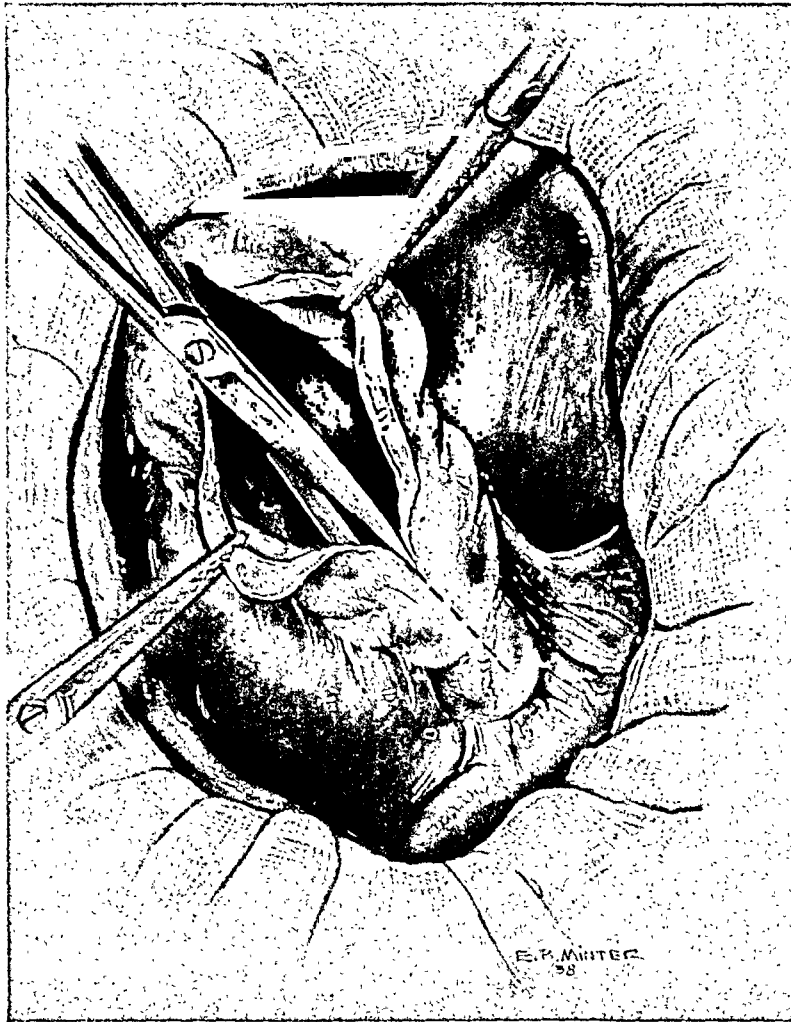


FIG. 2. After incising the fundus, removing the stones and swabbing the gall-bladder mucosa thoroughly with iodine, the gall-bladder is split with scissors down to within 1 cm. of the cystic duct.

All investigators agree that many cases of advanced gangrene may be quite deceptive in the mildness of the complaint and symptoms present. Even the leucocyte count may show but little change, except for a high polymorphonucleosis. Even when local perforation has taken place, the symptoms may, apparently, be quite insignificant. To attempt to gauge the pathologic process by the clinical symptoms is exceedingly difficult because so many cases present but a mild reaction to what may prove at operation an advanced suppurating and gangrenous lesion. Therefore the differential diagnosis of acute

stances downright impossible to make with any certainty.

*Treatment.* These cases must be under constant and careful observation because a gangrenous fulminating cholecystitis requires timely surgical intervention.

The only indication for *immediate* or *emergency* operation is the presence of symptoms of perforation with a spreading peritonitis. However, if gangrene is suspected, *early* operation must be definitely considered. Each case must be settled on its individual merits. Most patients require twenty-four to forty-eight hours (or even longer) of careful preparation, with mor-

phine for sedation, a high carbohydrate, liquid or semi-solid diet, intravenous glucose to promote and sustain adequate liver

tion, but that the mortality of acute cholecystitis must be lowered by every means known (which should include early opera-



FIG. 3. One-half of the redundant portion of the gall-bladder has been removed and the cut edge sutured with a lock stitch. The remaining half is being cut away and its cut edge will be similarly sutured.

function, the maintenance of fluid balance, and sometimes transfusion. Operation should take place in an afebrile period, if possible.

Evidence of spreading or increasing sup-puration or failure of some amelioration of the symptoms, is an indication for prompt surgery. Taylor's study indicated that where the interval between acute onset and operation reaches five days or more there is a rapid increase in mortality. Heuer believes the dangers of operation in acute cholecystitis have been over-emphasized, that acute cholecystitis is not an emergency requiring immediate opera-

tion). On the other hand, Graham<sup>8</sup> believes that only a very small percentage of acute gall-bladder lesions will require operation, and that it is best and safest to wait until there is a complete subsidence of acute symptoms before operation is undertaken.

*Type of Operation.* The gall-bladder should be removed whenever possible. Cholecystectomy from above downward will be found to be technically easier in these hugely distended, thick gall-bladders. When the inflammation and induration extend to the common duct area, fixing the cystic duct and making it difficult to isolate, and in the bad risk patient

when the trauma of a complete cholecystectomy might result in fatality, a partial cholecystectomy has proved ex-

There was one death (mortality rate 2 per cent), in a case in which partial cholecystectomy was used.



FIG. 4. Cigarette drains in place, holding open the remnant of the gall-bladder attached to the liver. The omentum is placed against the drains to prevent adhesions to the nearby viscera.

ceedingly valuable. In the very bad risk patient, cholecystostomy may be the only operation with a proper factor of safety. In the presence of jaundice and very obvious common duct involvement, cholecystostomy should be considered the first part of a two-stage procedure, the second being a cholecystectomy with exploration of the common duct.

An analysis of our last fifty cases of acute suppurative and gangrenous cholecystitis shows:

Cholecystectomy was employed in...	20
Partial cholecystectomy in.....	25
Cholecystostomy in.....	5

#### PARTIAL CHOLECYSTECTOMY

*Operative Procedure.* The gall-bladder is exposed by an incision through the upper right rectus muscle or one parallel to the costal margin. The area involved is isolated by gauze packs, and the adhesions to the gall-bladder are freed. The gall-bladder is aspirated of its fluid contents. (Fig. 1.) The fundus is then incised and the stones removed. The gall-bladder is dried with gauze, swabbed with tincture of iodine, and split with scissors down to within 1 to 2 cm. of the cystic duct. (Fig. 2.) This often facilitates the removal of a stone impacted

at the junction of the ampulla and cystic duct which cannot be evacuated otherwise. The gall-bladder is then partially removed, by trimming off the redundant part of each half down to the border of the liver fossa, leaving that portion attached to the liver. The bleeding from these cut edges is controlled by ligature or lock stitch up each side. (Fig. 3.) Two or three cigarette drains are placed about the cystic duct and brought out against the remnant of the gall-bladder to hold it open. (Fig. 4.) A tube may be placed at the opening of the cystic duct which is not ligated or tied off in any way. The greater omentum or the thickened plastic gastrocolic omentum is placed against the drains to separate them from the nearby viscera. (Fig. 4.) The drains are then either brought out through the operative wound or through a lateral stab wound directly over the gall-bladder remnant and the wound closed.

We have used pure carbolic acid or the actual cautery in a few cases instead of tincture of iodine to destroy the mucous membrane of the remaining bit of gall-bladder. However, since we have found that in the early cases in which iodine was used there was no evidence of gall-bladder reformation, iodine has recently been uniformly applied to avoid the possibility that an eschar or necrosis in the presence of infection might prolong convalescence. One case in which the cautery was employed seemed to indicate this possibility. Thorek's method of destroying the mucosa by bipolar diathermy can be used.

**Indications.** We have performed partial cholecystectomy in forty-eight cases. In forty-four it was used because of an acute suppurating or gangrenous gall-bladder with induration about the cystic and common duct; in four, it was used because of very difficult exposure in a small contracted gall-bladder densely adherent to the liver.

**Mortality.** There has been one death—a mortality rate of 2.08 per cent. (If only the forty-four suppurative and gangrenous cases are considered the mortality rate would be 2.27 per cent.) This fatality

occurred in a woman of sixty-five years with advanced myocardial disease and a very large gangrenous gall-bladder. She had recovered, apparently, very well, and was about to be discharged from the hospital on the sixteenth post-operative day when she developed a large pulmonary embolus.

**Follow-Up Statistics** (Table 1). A careful personal follow-up examination has been obtained in all but five cases, i.e., in forty-two.

TABLE 1  
END RESULTS

1. Mortality (operative)	
48 cases—1 death—2.08 per cent post-operative mortality rate.	
2. Follow-up record	
(47 cases followed from 1 to 12 years)	
(a) No report.....	5
(b) Symptom-free without dietary restrictions.....	34 (81 per cent of those from whom reports were obtained.)
(c) Well except for dietary restrictions.....	5 11.9 per cent
Two have had symptoms suggesting common duct disease.	
(d) Proved common duct involvement requiring operation four months and six, eight, and nine years respectively after partial cholecystectomy.....	4 9.5 per cent
Total.....	48
3. Post-operative hernia (None requiring operation).....	6 14.3 per cent
4. Fate of remnant of gall-bladder allowed to remain.	
Four cases personally reoperated showed dense adhesions over the gall-bladder fossa, but no vestige of anything resembling a gall-bladder or gall-bladder remnant.	

1. Relief of Symptoms. Thirty-four (81 per cent) have remained well and free from any complaint referable to the gall-bladder. Five (11.9 per cent) require a slight dietary restriction, low fat diet, because of bloating and belching after meals. There have been no reoperations because of recurrent gall-bladder disease. Frequently, after the third or fourth post-operative day there is a free discharge of bile, but the sinus has healed readily after the drains are removed, except in one case with common duct involvement which required choledochos-

tomy four months subsequent to partial cholecystectomy.

2. Subsequent Common Duct Involvement. Four cases (9.5 per cent) have required operation for stones in the common duct four months and six, eight and nine years respectively after partial cholecystectomy. Also, two of the five cases requiring dietary restrictions have had transitory symptoms of jaundice, epigastric pain, and vomiting at long intervals. One of these has remained symptom-free for eight years and now has diabetes. In another case, ten stones were removed from the common duct coincident with the partial cholecystectomy. As a rule, however, with the extensive induration and inflammation about the common duct in the type of case in which partial cholecystectomy is indicated, simultaneous exploration or operation on the common duct is rarely advisable because of the added operative risk and excess trauma involved in the technical difficulties of exposure and control of hemorrhage and infection. Ordinarily, if common duct involvement is definitely known to exist at the time of operation, a two-stage procedure had best be planned.

3. Fate of the Remnant of the Gall-Bladder Allowed to Remain. In four cases I have had the opportunity to reoperate. Two required hysterectomy and in these the gall-bladder area was simply palpated. There were dense adhesions to the gall-bladder fossa, but no evidence of any thickening to suggest its reformation. The third case was one which necessitated choledochostomy for stones eight years after the partial cholecystectomy. There were adhesions of the gastrocolic omentum and thickening of the capsule of the liver over the gall-bladder fossa, but no vestige of anything that even resembled the gall-bladder or a gall-bladder remnant. The fourth was the case with persistent fistula which required choledochostomy four months after the primary operation. There was a dilatation of the fistula close to the common duct, apparently the cystic duct

3 cm. in length, but nothing recognizable as a reformed gall-bladder.

4. Post-Operative Hernia. This occurred in six cases (14.3 per cent). Inasmuch as extensive drainage is necessary with partial cholecystectomy—at least three drains are usually required—post-operative hernia might readily be expected, except in those cases where the drains are brought out through a lateral stab incision. In most of the scars an opening in the fascia at the point of drainage could be palpated, but only in six was there a definite hernia; one in an old obese man of 76 was large and gave obstruction symptoms, but he has consistently refused all thought of operative relief.

*Comment.* This operation would seem to have its particular application in acute suppurative or gangrenous cholecystitis or empyema of the gall-bladder, *especially when there is induration about the cystic and common ducts.* In no way should a partial cholecystectomy be considered to supplant a *complete* cholecystectomy when the complete removal can be *safely accomplished.* Those operators exceptionally skilful in the use of cholecystectomy from above downward may find less use for partial cholecystectomy than those whose proficiency has been directed to cholecystectomy from below upward. Furthermore, though cholecystostomy must still be reserved for the exceptionally bad risk patient, fewer cholecystostomies seem indicated when familiarity with partial cholecystectomy has been acquired.

Partial cholecystectomy should have a very restricted field. End results in forty-eight cases would seem to demonstrate:

1. That it does act as a cholecystectomy, i.e., no reformation of the gall-bladder or stones occurs subsequently.

2. It would seem to give end results comparable to cholecystectomy for cholelithiasis: 81 per cent completely well; 11.9 per cent well with dietary restrictions.

3. Post-operative common duct involvement may occasionally occur. (9.5 per cent.)



4. When carefully and reasonably employed it is attended by a surprisingly low mortality.

**Discussion.** Partial cholecystectomy for gangrenous cholecystitis has been used by many, notably by E. DeNegre Martin,<sup>14</sup> DeMartel,<sup>5</sup> Zabala and Bengoela,<sup>29</sup> Pauchet,<sup>20</sup> Haggard,<sup>11</sup> McKenty<sup>15</sup> and Ritchie.<sup>21</sup> Thorek's<sup>27</sup> technique of cholecyst-electro-coagulectomy is somewhat similar and is, apparently, applicable to acute gall-bladder lesions. The only extensive series in acute gangrenous cholecystitis besides ours are McKenty's and Ritchie's. McKenty reports thirty-three cases with one death. Ritchie, after splitting the gall-bladder and excising the "wings," removes the mucous membrane of the portion allowed to remain, sutures a tube into the stump of the ampulla and cystic duct and closes the denuded gall-bladder remnant by suture. He cites sixteen cases with no mortality. By combining McKenty's, Ritchie's, and our series, we obtain a total of ninety-three cases with two deaths, a mortality of 2.15 per cent.

Post-operative mortality in acute cholecystitis has been reported as 13.5 per cent by Miller,<sup>16</sup> 9.3 per cent by Smith,<sup>24</sup> 5.5 per cent by H. F. Graham,<sup>9</sup> 4.7 per cent by Judd and Phillips,<sup>10</sup> and 3.2 per cent by Heuer<sup>12,13</sup>; these include all types of acute gall-bladder disease. Partial cholecystectomy used only in the advanced gangrenous case with a post-operative mortality of 2.15 per cent would seem to indicate that there is a definite field for this procedure. The question may be raised as to whether permitting the portion of the gall-bladder attached to the liver to remain may not minimize trauma to the liver and be a factor in lowering the mortality.

#### CONCLUSIONS

1. Acute gangrenous cholecystitis results most commonly from a stone impacted in the cystic duct or at the juncture of the gall-bladder ampulla with the cystic duct. It may be complicated by perforation with local abscess or peritonitis.

2. Its differentiation from other types of acute gall-bladder disease may be quite difficult.

#### 3. Treatment:

- (a) Cholecystectomy is the operation of choice, but may yield too high a mortality if applied universally.
- (b) Partial cholecystectomy may be indicated in the advanced case with induration about the cystic and common ducts. Follow-up study demonstrates end results comparable to complete cholecystectomy with a *very low post-operative mortality*.
- (c) Cholecystostomy must be reserved for the very bad risk case.
- (d) The use of partial cholecystectomy when indicated may prove a factor in lowering post-operative mortality.

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# INDICATIONS FOR OPERATION IN GALL-BLADDER DISEASE\*

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IT is known that many individuals, in excellent state of health and living to advanced age, have gallstones and never have them removed. In 612 routine post-mortem examinations at the Mayo Clinic, Mentzer found evidence of cholecystic disease in 66 per cent, yet in but 8 per cent had a primary diagnosis of cholecystitis been made. Probably one woman out of every twelve to fifteen above the age of forty has chronic gall-bladder disease, but probably less than one half ever experience serious effects. It is, however, reasonable and scientifically sound to advise operation once the diagnosis of gallstones is made. While many patients escape serious consequences, neglected chronic cholecystic disease, with the grave complications it may produce, accounts for thousands of deaths each year. No one can predict how long a "silent" gallstone will remain silent.

Much has recently been said regarding the stoneless gall-bladder or "non-calculus cholecystitis." No one will deny the existence of chronic inflammatory processes within the gall-bladder, unassociated with stones or cholesterosis. Countless needless cholecystectomies are being performed, however, on vague symptoms and most inadequate evidence. Usually the diagnosis of "chronic cholecystitis" is the one rendered and is often confirmed in the laboratory, for any pathologist possessing a keen imagination and an inordinate desire to support the surgeon, can find trouble in any gall-bladder.

While it is accepted that many patients have gallstones without ill effects, most individuals with gallstones present symp-

toms that are unmistakable. With such patients the indications are clear. It is my opinion, however, that not one patient out of ten operated upon on the usually meager symptoms of "non-calculus cholecystitis," and whose gall-bladder shows no stones or gross pathologic changes, has sufficient disease to warrant subjecting him to a relatively formidable operation.

I seriously doubt if as many patients suffering from alleged chronic cholecystitis have actual disease as we are led to believe, especially by those whose cholecystectomy statistics reveal a high percentage of operations performed for "non-calculus" cholecystitis. That the latter condition does occur no one will doubt, my thesis merely being that too many normal gall-bladders are removed on incomplete evidence—with nothing achieved other than to make the patient worse. It has been my experience that most patients with positive cholecystic disease, probably 80 per cent of them, present symptoms that are clear and unmistakable. If there is doubt in the indefinite or borderline case, the cholecystogram can largely be relied upon to confirm or rule out the diagnosis.

The patient presenting the symptoms of flatulence, chronic constipation, qualitative food intolerance, epigastric discomfort soon after eating, must not necessarily be considered as having gall-bladder disease. Duodenal or gastric ulcer, chronic gastritis or duodenitis, appendiceal inflammation, renal conditions, etc., may frequently account for the symptoms. The majority of these patients will have nothing but "indigestion," probably nothing but "nervous indigestion," so well described by Alvarez

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—and no laparotomy or post-mortem examination will reveal organic disease to account for it. I think it is about time to state this, and emphatically, the over-zealous surgeon who habitually performs cholecystectomies on the most meager clinical pictures and removes what are, actually, normal gall-bladders to the contrary notwithstanding. The illusive diagnosis of chronic non-calculous cholecystitis must be fully confirmed by most thorough studies before the patient is subjected to operation.

Many women, and some men, who are entirely symptom-free, are found during the course of operations on other abdominal or pelvic structures, to have gallstones. In some instances the stones are first revealed by the x-ray. The internist may suggest that these patients be treated, at least until symptoms develop, medically, and yet what could be more futile than the medical treatment of gallstones. Bearing in mind the dangers of acute empyema, common duct obstruction, jaundice, liver abscess, acute pancreatitis and a host of complications which may be precipitated by neglected gallstones, and recalling the simplicity of the modern operation of cholecystectomy, the low mortality and the good results which almost always follow at the hands of an experienced surgeon, the indications are usually for operation once the diagnosis is made.

The cholecystogram is of great help in borderline or indefinite cases, but must be interpreted by a skilled roentgenologist. A gall-bladder filled with stones may function normally, while one devoid of calculi may fail to cast a shadow. The indications are for exploration in the presence of a definite history in spite of a normal cholecystogram. Per contra, a positive cholecystogram, unassociated with a significant history, may lead one into a needless operation unless the evidence is made more convincing by repeated tests and examinations.

In the absence of colics and when the patient has otherwise a "typical biliary

history," indications for operation are by no means clear. Indefinite distress in the upper abdomen, bloating, gas belching, occurring without associated attacks of acute epigastric pain, require careful evaluation before a positive diagnosis of gall-bladder disease can be made and operation advised. However, patients with gallstones or well defined chronic cholecystitis, even without stones but requiring surgery, nearly always present clear-cut histories and, usually, a positive cholecystogram. I am sure this is true in 80 per cent of the cases. It is with the remaining 20 per cent that the keenest judgment must be exercised. Judgment, however, is not the only desideratum—a clear conscience is also desirable.

There has been much interesting debate over the question of the indications for operation in acute cholecystitis. While some surgeons advance valid arguments for delay, this having been the accepted plan until a few years ago, others (Heuer, Walters, Judd, et al.), appreciating the dangers of gangrene or perforation and supporting their attitude by convincing data, urge immediate cholecystectomy. The latter viewpoint is the one receiving the wider acceptance, but the indications cannot be as dogmatically set forth, as with, for instance, perforated peptic ulcer or acute appendicitis. Every case of acute cholecystitis is a law unto itself and must be judged on its own merits.

The risk of early operation in acute cholecystitis, gangrenous or otherwise, is great, but not so great as the risk of delay. It is impossible to determine accurately the nature of the process, its severity, the extent of walling off or the amount of necrosis which has taken place in the gall bladder itself. Exploration must be resorted to before accurate knowledge of the condition can be obtained. While the temperature curve, the leucocyte count, the degree of fever, the amount of pain, rigidity, and size of a mass, if present, all are of help, it is usually necessary to see the gall-bladder before

the extent of the pathologic process within it can be estimated.

Results following operations upon the gall-bladder or biliary ducts will vary greatly according to the skill of the surgeon. With no type of abdominal operation, especially when the patient is in the hands of an inexperienced operator, is there greater possibility of causing serious and occasionally fatal damage. Failure carefully to examine the common duct, when stones may be present; injury to the common duct itself; or the incomplete operation of cholecystostomy (unless clearly indicated) may result in driving the patient back to the operating table for the second, third, or even fourth time.

Indications for exploration in painless jaundice are not always clearly defined. If there have been periods of remission, obstruction from stones should be thought of, but if the jaundice is acute, progressive, and painless, neoplastic disease, either primary in the biliary ducts or metastatic in the liver, or occurring as an original growth in the head of the pancreas, must be suspected. Occasionally, under such circumstances, a cholecyst-duodenostomy will afford months of relief.

Routine autopsies in large hospitals here and in Europe have shown that nearly 20 per cent of all adults have evidences of gallstones. There should be, however, positive clinical evidence of their presence before operation is advised. The sympathetic nerves through the superior and inferior mesenteric ganglion are closely linked with the stomach, duodenum, right kidney, ureter and colon as well as with the gall-bladder, a fact accounting not infrequently for confusion in interpreting symptoms of supposed cholecystic disease.

The operation of choice, once the indications are established is, of course, cholecystectomy. Drainage of the gall-bladder, while occasionally required, has been found to be an incomplete and unsatisfactory operation, often leading to reoperation. Even in acute cholecystitis with acute empyema in our experience cholecystec-

tomy has been incomparably the better procedure—yet here again each case is a law unto itself. Much will depend on the patient's age, his general condition, and the duration, extent and type of infection.

Indications for exploration of the common duct are well established. If the patient is or has been jaundiced, if the gall bladder is found small and contracted, or the common duct edematous, thickened and enlarged, and, of course, if stones can be palpated within it, then the duct must surely be explored. Common duct calculi are being repeatedly overlooked during the performance of simple cholecystectomy. Far too many patients are being forced to submit to subsequent operations because of common duct stones missed during the performance of inexpertly conducted explorations.

In gallstones, surely if producing colic, in acute cholecystitis, in tumors of the gall-bladder, in acute empyema, resulting from cystic blockage, in acute hydrops, in true chronic cholecystitis, especially if diffuse cholesterosis can be demonstrated, in obstructive jaundice the indications are always for operation.

No one will deny the existence of chronic cholecystitis in the stoneless gall-bladder; yet operations in such conditions are so frequently followed by poor results that surgery should be advised only with great caution, even though the diagnosis has been made. Graham puts the unsatisfactory results in cholecystectomy for such conditions at 40 per cent. The severity of the symptoms in assumed chronic cholecystitis fluctuates markedly, often in a manner corresponding to the patient's degree of nervous instability and often to so wide an extent that differentiation between what is functional and what organic is next to impossible.

Before me is the summary of 1,634 patients upon whom I have operated for gall-bladder or biliary duct disease. Many of these operations have been life saving. The results in nearly all have been satisfactory. Yet there are the outstanding

exceptions and these the very few patients operated upon for "chronic cholecystitis" in whom the indications were based on the uncertain and indeterminate syndrome usually associated with indigestion of assumed biliary origin. These patients were improved for a month or two, but later follow-up studies invariably revealed them to be no better, and often to be worse. Such a confession can be made by any surgeon who has had a large experience in gall-bladder surgery.

As one's experience in the treatment of gall-bladder disease grows, one is bound to become increasingly convinced that surgical procedures on the biliary system, unless gallstones are present or there are well established evidences of advancing inflammatory disease, should be withheld, and that the overly zealous surgeon who fails to accept this idea is a greater menace than the disease he aims to treat. This may seem to be an unreasonably iconoclastic attitude but it is based on an experience obtained in examining many patients who have been operated upon "elsewhere" for alleged chronic cholecystitis without stones and who are still clamoring for relief.

It is appropriate, lest this theme is played upon too long, to state that for every patient needlessly cholecystectomized, there must be hundreds who most desperately require operation and who, through their own negligence or that of their physicians, are denied the opportunity for adequate and early relief until they appear in the operating theater after empyema, gangrene, abscess, rupture, common duct obstruction, jaundice, diffusing hepatitis or pancreatitis have developed, singly or in combination, with far too frequently a fatal termination.

In closing one might make the trite statement, threadbare though it may be: Here is one of the commonest of abdominal diseases, one in which the diagnosis in most instances is a matter of relative simplicity, the treatment of which is perfectly established, and the results, if operation is promptly carried out and expertly performed, excellent with 95 per cent of patients. Yet the diagnosis must be accurately made before the operation is attempted and no operation thought of unless such a diagnosis is made.



# COMMON AND HEPATIC DUCT STONES\*

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THAT gallstones occur in a great many people is, of course, a demonstrated and accepted fact today, and that they produce distress and discomfort, that they result in loss of time in many individuals and that they produce fatalities in others is likewise accepted.

The logical approach to the management of the gallstone problem would, of course, be the prevention of their occurrence and since this is not as yet possible nor is there any evidence of its immediate accomplishment, the next most logical approach is to discuss whether it is safer for a given individual to keep his gallstones with no operation or to have them removed by operation. It must be accepted, we believe, that with the exception of simple dietary precautions, there is no real medical treatment of gallstones. It is probable that if people eat reasonably, maintain proper bowel function and live reasonably, the number of attacks of gallstones may well be lessened. On the other hand, since there is no real time element in the occurrence of gallstone colic or local pain, since this appears to be purely a matter of chance, one can never be sure as to whether or not the relief accomplished without operation is the result of chance or care.

With the above facts in mind, another question to settle is if such patients are not operated upon what are the disadvantages that they suffer? In many cases, indigestion, in others, severe pain, and surely in others, actual fatalities occur. Another consideration which must always arise in the question of deferring operation for gallstones is the fact that in patients known to have gallstones but not operated upon,

there is always the possibility that acute emergencies such as acute cholecystitis, deep jaundice and obstruction caused by stones in the common bile duct, may occur after patients are advanced in age when they are not good subjects for surgical procedures.

We have always been of the conviction that there are no harmless gallstones and that because of the above dangers and disadvantages all gallstones should be removed. It has frequently been urged and practiced that a proper attitude to take toward gallstones is that operation should not be undertaken until they produce symptoms. If one deals with gallstone patients in large numbers one cannot help being impressed with the fact that this philosophy results in many serious situations and in fatalities which would not have occurred had the operative procedure been undertaken earlier.

If early operation be accepted as the most desirable way to manage patients with gallstones whether or not they produce symptoms, then all physical examinations should include investigations of the gall-bladder in order that stones may be demonstrated early in their occurrence and removed before pathologic changes have taken place, and the gall-bladder removed with its contained stones before changes have taken place in the common bile and hepatic ducts. If all patients could be operated upon for gallstones early in the course of the disease before there are many pathologic changes in the wall of the gall-bladder or many adhesions about it and before marked infection had taken place within the common bile and hepatic ducts

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and their biliary branches, the mortality and morbidity in this group of patients would be almost trivial.

When operation is deferred, as is so commonly the case today, until it is done in the late stages of gallstones after they have existed for a considerable period of time, the situation then is not infrequently complicated by the presence of acute infection in the form of acute cholecystitis, common and hepatic duct stones, jaundice, hemorrhage and the likelihood of recurrence of stones in the common bile and hepatic ducts, even though they are all successfully removed, together with the gall-bladder and its contained stones.

Exclusive of those cases of acute and subacute cholecystitis which represent in reality but a small percentage of all the cases of gallstones, and exclusive of acute perforations which represent a minimal percentage of all of the cases of gallstones, the mortality factor directly attributable to the condition itself and not to the operative procedure, is largely that which results from long-standing gallstones in the gall-bladder, long-standing infection in the gall-bladder, and long-standing contamination within the common and hepatic ducts from the infected gall-bladder. This infection produces in the walls of the common and hepatic ducts the same condition which produces stones in the gall-bladder and in a similar way results in the production of common and hepatic duct stones. Permanent changes are produced in the wall of the common bile and hepatic ducts which, if the infection has been of sufficiently long standing and the resulting changes sufficiently extensive, result also in the frequent recurrence of the common and hepatic duct stones even though they are successfully and completely removed together with the gall-bladder and its contained stones.

There has been a great deal written and spoken concerning the production of common duct stones by their migration from the gall-bladder into the common bile duct. That this occasionally occurs with very small stones there is no doubt. From a large

experience now, amounting to 2,177 patients operated upon for gallstones, in approximately 20 per cent of whom of late years common duct stones have been regularly demonstrated and removed, we are positively of the conviction that most common and hepatic duct stones are not

TABLE I  
COMMON DUCT STONES

	Exploration		Stones found		Total Cases
	Num-ber	Per Cent	Num-ber	Per Cent	
1910 to 1926	96	15.0	52	8.4	619
1927 to 1928	91	32.7	38	13.7	278
1929 to 1930	49	35.8	22	16.1	137
1930 to 1931	61	42.5	30	21.0	138
1931 to 1932	45	38.0	22	19.0	118
1932 to 1933	52	46.0	24	21.2	113
1933 to 1934	42	35.0	21	17.6	119
1934 to 1935	48	35.0	17	12.0	143
1935 to 1936	67	46.2	28	19.3	145
1936 to 1937	74	40.2	23	14.4	159
1937 to 1938	95	50.8	34	18.3	187

produced in the gall-bladder but originate primarily within the common and hepatic bile ducts. They are the results of the long-standing infection which produces the pathologic changes in the walls of the common and hepatic ducts. It is these changes which make the structures capable of producing gallstones in the ducts, just as they are produced in the gall-bladder when the pathology has occurred in the walls of that structure.

We believe from our experience that the theory that most common duct stones have progressed from the gall-bladder into the common and hepatic ducts is one of the reasons why more common duct stones have not been found and demonstrated. The fact that more common duct stones have not been found is also undoubtedly related to the size of the cystic duct. If the cystic duct at operation has been found to be small, and obviously of such caliber that stones would be unlikely to pass through it, it has at times in the past been assumed that stones could not be present

in the common and hepatic ducts. This, however, is in no way a dependable criterion. Again and again we have found and removed stones in the common bile duct when the cystic duct was so small that even the smallest stone of bird-shot caliber would have had trouble in passing through it. It is because of this experience that we became more and more convinced that certainly a great majority of stones in the common bile and hepatic ducts originate there as the result of infection of these structures.

Some years ago (1926) we became convinced from our own experience in operating upon many patients with gallstones (619) that the situation in regard to possible common and hepatic duct stones needed modifying. We became convinced from a review of our own patients that we were too content with our methods of dealing with gallstones when we, in most cases, merely removed the gall-bladder. We became convinced that if one waited for the evidence then accepted as to the possible presence of common and hepatic duct stones, that is, jaundice, that many common duct stones which did and could cause serious situations would be overlooked and would not be removed until they had become associated with serious complications. We believe that as a result of agitation by ourselves and others regarding the need for exploring the common bile duct in a much higher percentage of cases than used to be done, many more common duct stones are now being found. We believe, however, that there is still more missionary work to be done upon this subject. There are still many who take the improper attitude that if the common bile duct is not dilated, stones are probably not present, and others who take the position that if jaundice is not present, it is unlikely that stones are present in the common and hepatic ducts, and still others who take the position that if stones cannot be felt in the common and hepatic ducts it is unlikely that they are present. All of these criteria for opening and

investigating the common and hepatic ducts are quite wrong and represent the attitude which has been present up to recent years and which has resulted in much of the morbidity and some of the mortality which has followed cholecystectomy for gallstones.

We have progressed through two eras in the surgical management of gallstones and are now, we believe, in the third era. In the first of these periods, we attempted to relieve patients permanently of gallstones by opening their gall-bladders and removing the stones, but this resulted in so many of the patients having a recurrence of their gallstones or cholecystitis in the remaining gall-bladder that the procedure was quite universally given up. We next progressed to cholecystectomy, with the removal of the gallstones and the infected gall-bladder, with great improvement in end results in the treatment of gallstones but with many common duct stones overlooked and later producing symptoms and fatalities. We are now in the third era in which, in at least 40 per cent of the cases, not only is the gall-bladder removed but the common bile duct is opened, investigated and any demonstrated stones removed, the sphincter of Oddi dilated and internal drainage of bile established.

We have now operated upon 2,177 patients for gallstones. We have for the past ten years, by writings and talks on this subject, urged the necessity of more often opening and searching common and hepatic ducts for possible stones within the ducts if we wish to relieve these patients completely of the difficulties for which they submitted to operation and to maintain the relief with reasonable permanency. During this time we have opened and explored the common or hepatic ducts in 718 cases and in this experience we have found and removed common and hepatic duct stones in 323 cases.

As the result of this experience we wish to record some of our convictions.

If one is to be as certain as possible that in the greatest possible number of patients



all gallstones are removed from the common and hepatic ducts, many explorations of ducts must be done upon suspicion, and in at least one-half of the cases no stones will be found. The opening and investigation of the common and hepatic ducts, together with the introduction of a short T-tube into the duct for twelve to fourteen days, does not, in the hands of experienced operators, either add to the mortality of the operative procedure or prolong the hospital stay. When one hears the statement that investigations of the bile ducts by inexperienced operators in such a high percentage of cases as we advocate will result in many complications and a higher mortality, one must be careful to realize that this mortality is not attributable to the plan but to the individual.

A common or hepatic duct of normal size or with normal walls is no assurance that a small common duct stone may not be found at the ampulla of Vater. Surgeons have in the past become so used to operating upon patients in late stages of common and hepatic duct stones with dilated ducts with thickened walls, that many tend not to appreciate that there is an early stage in their formation in which the common duct stone is so small that the secretory pressure of bile forces it down to the ampulla of Vater through which it does not pass. Because of its small size it does not interfere with drainage through the sphincter of Oddi and so fails to produce dilatation of the ducts or jaundice. This is the ideal duct stone to remove. With the removal of the gall-bladder, further contamination of the ducts is eliminated and the removal of the small stone does away with the nucleus upon which is developed the obstructing stone of larger size.

One of the best and most practical demonstrations of how necessary it is for us to change our past attitude toward possible common duct stones is the fact that in 39 per cent of the cases in which we have found and removed common or hepatic duct stones, jaundice was not present at the time of the removal of the

stones and had never been present in the past history. When one realizes that the feature which used to indicate to us the possibility of common or hepatic duct stone (jaundice) was absent in more than a third of the cases, it is readily appreciated that if one waits for this as an indication for investigation of the ducts many duct stones will be overlooked and left behind to cause later symptoms and require reoperation.

In past writings on this subject we have listed the following indications for exploration of the ducts at the time of cholecystectomy:

1. *When the gall-bladder is contracted.* This, we believe, is one of the most reliable indications for investigation of the common and hepatic ducts at the time of operation, whether or not a stone can be palpated and whether or not jaundice is present. In very few cases in which the gall-bladder is found to be contracted will there fail to be dilatation of the common and hepatic ducts. This dilatation in itself is likewise a quite dependable indication of the possible presence of stones in the ducts. The small fibrotic and contracted gall-bladder is not itself the causative factor in the possible presence of stones in the ducts, but rather the conditions that bring about the contraction of the gall-bladder are the causative factors in the production of stones within the ducts. The fact that a gall-bladder normally the size of a small pear can, as the result of long-standing chronic inflammation in its walls and within its sac, contract by cicatrization down to the size of a peanut is evidence that the common and hepatic ducts are constantly being contaminated by this infection. The walls of the ducts become involved in the same inflammatory process and thus the production of stones within the ducts becomes probable.

In the same way rarely do common and hepatic ducts become dilated except when their walls have become pathologically changed by inflammatory processes or when they have been mechanically dilated

by an obstructing stone. Since, as already stated, we have repeatedly removed stones from ducts that were not dilated and were grossly normal in appearance, it cannot be assumed with safety that if a duct is not dilated a stone is not present.

2. Obviously, when *jaundice* is or has been present with attacks of gallstone colic and when stones are present in the gall-bladder, the common and hepatic ducts must be investigated if we wish to be certain that stones in the ducts are not left behind. In this connection it is of interest to record that in the cases in which we have found and removed stones from the ducts, stones were removed from the ducts and no stones found in the gall-bladder in 4 per cent of the cases. It cannot be assumed, therefore, that because there are no stones in the gall-bladder there are no stones in the common or hepatic ducts.

3. It is, of course, scarcely necessary to state that the ducts should be opened and explored whenever, as the result of palpation of the ducts, one suspects that a *stone* can be felt.

The above indications for investigating the ducts at the time of exploration are still employed and useful. However, in the further experience with common and hepatic duct explorations, we have become convinced that a stone can actually exist in the lower end of the common duct without being palpable, and without a single indication such as jaundice or a single one of the features spoken of above being present. We have therefore become so impressed with the need of explorations, particularly of the lower end of the common bile duct, at the time of cholecystectomy for biliary tract infection or stones, that during the past year the common and hepatic ducts have been opened and explored in 50 per cent of the cases, the highest incidence of exploration of the ducts that has occurred in our experience. So frequently have we found and removed stones from the lower end of the common duct when there were absolutely no indica-

tions of their presence that we now tend to make the decision for or against exploration of the ducts very largely upon the appearance and contents of the gall-bladder when it is opened and inspected immediately after its removal.

Upon completing the cholecystectomy, the gall-bladder is immediately passed to a non-sterile head operating nurse who opens it and presents it to the operator for inspection. Whenever there are marked evidences of long-standing infection in its walls, such as thickening or fibrosis; or whenever its contained bile is of the thick, black and tenacious type so frequently associated with old infection, the ducts are explored regardless of how normal they appear to be. In patients other than those with contracted gall-bladders, jaundice past or present, or in whose ducts a stone can be felt or whose ducts are dilated (in those cases all ducts are explored), the decision for or against exploration of the ducts is by no means easy. It is the percentage of ducts explored in this group that influences so greatly the percentage of all operations in which ducts are explored and particularly controls the number of small, unsuspected stones removed from the lower end of the common duct.

As a result of this relatively large experience in making decisions for or against exploration of common and hepatic ducts, and as the result of removing a considerable number of common and hepatic duct stones (323 cases), certain technical features of the operation have been impressed upon us. It has frequently been of value when we have been uncertain as to whether or not to open a duct, to introduce a hypodermic needle into it, withdraw some of the bile, and look at it in the syringe through transmitted light. If the bile is clear and golden yellow in color, rarely will stones be found at the lower end of the duct. If, on the other hand, the bile is cloudy, black or contains flocculi, rarely will stones *fail* to be found at the lower end of the common duct. When such infected bile is present, even though stones are not found, opening and

draining the duct will still have been an advantage.

Another technical feature which has proved of value to us is the need of introducing a hypodermic needle into a dilated duct. If a surgeon has operated upon a large number of patients for common duct stones, he will become so familiar with the anatomy of this region that he may well feel it unnecessary to be certain that a dilated structure is a common bile duct because of such frequent contact with this situation. Such a case arose in our experience only three or four months ago. In a contracted gall-bladder, we met what appeared to be an enormously dilated hepatic and common duct, with a cystic duct running into it. There seemed almost no question that the dilated structure was a common bile duct and yet because of the fact that we wished (1) to determine the character of the bile within the duct, and (2) to be certain that it was duct, a hypodermic needle was introduced. It proved to be a portal vein on top of the duct, with the cystic duct running around the portal vein and entering the common duct which was directly behind the vein. This experience demonstrated to us that even after a large experience with surgery of the common bile duct, one could by mistake open a portal vein, that the introduction of a hypodermic needle to sample the contents of the structure causes no difficulty whatsoever, and once in a very great while will save one from a surgical calamity.

We have for a number of years preached the necessity of clamping and cutting the cystic artery, before the junction of a cystic duct and the common and hepatic ducts is demonstrated. We particularly urge that this be done, that the dissections of the junction of the cystic, common and hepatic ducts be made in an absolutely dry field and under adequate exposure. We urge this because of the fact that we have not infrequently seen accessory ducts here which might readily be torn, leak bile profusely and result in wound or other post-operative complication. Most acces-

sory bile ducts are of very small caliber, and even though unsecured, will produce a flow of bile from the wound for only a few days post-operatively. We have, however, recently seen an accessory bile duct coming out from the bed of the liver which would discharge bile at the rate of a teaspoonful or more per minute. It is, therefore, we believe, quite necessary accurately to demonstrate the structures in this region and to ligate and control any possible accessory ducts.

Now that it is possible to dilate the sphincter of Oddi by means of the Backus dilators, it is, we believe, almost never necessary to make incisions in the duodenum and do transduodenal choledochostomy. When a stone is so small that it cannot be demonstrated by palpation, dilation of the sphincter of Oddi up to 9 mm. will permit most stones of this diameter to be washed through into the duodenum by irrigation. When they are of a size greater than this, they usually can be picked up by the forceps introduced through an incision in the common bile duct and withdrawn. We have but once in the last two years been forced to do a transduodenal choledochostomy and that was for a branched type of stone, one angle of which was lodged in the pancreatic duct.

When a common bile duct is to be opened, it is desirable to do so as close to the edge of the duodenum as possible in order that the surgeon may not have to reach down to the ampulla of Vater over any greater distance than necessary. On the other hand, we have found it extremely important not to make the incision so close to the duodenum that, after a T-tube is sutured into it, the tube will rest against the duodenum and encourage the production of a duodenal fistula by pressure.

Concerning the importance of Backus dilators for dilatation of the sphincter of Oddi, as we have published in previous papers on this subject, such dilatation is now never carried above 9 mm. caliber. We have reported in the past, two patients

with apparent ascending gas bacillus infection which resulted fatally, when dilatations beyond this point were employed. Since we have limited our dilatations of the duct to dilators of this caliber we have not encountered such complications. Following the dilatation of the ducts we believe that fairly strong irrigation should be employed to wash any possible stones which have lodged at the lower end of the common bile duct, through the sphincter into the duodenum.

One of the important decisions to make regarding opening and removing stones from the common bile duct, concerns drainage. We have never closed a common or hepatic duct after it has been opened, since we believe it undesirable to close it by suture. All drainage of common ducts has been made by means of T-tubes. The transverse portion of the T is cut off until not less than one-eighth to one-fourth of an inch of the transverse portion remains on the upright limb. This is of advantage in that a large amount of foreign material is not placed in the duct and, at the time of removal, the tube comes away more easily than when long limbs are left within the duct. There is no advantage whatever in leaving long limbs within the duct and there are many advantages in cutting the transverse limbs as short as possible. We have never employed single straight catheter drainage tubes since we wish to clamp the upright limb of the T-tube draining through the abdominal wall at the end of six or seven days, in order that bile may be encouraged to pass into the duodenum as early as possible. It has been our experience that many patients are made much more comfortable as soon as the bile is delivered into the intestinal tract.

We have frequently been asked how long drainage is employed in the cases in which stones have been removed from the ducts or infection is present within the ducts. Our general rule of drainage has been that when a duct is not dilated; not abnormally thickened; and not obviously infected, even though a small stone is removed from its

lower end of the common bile duct; and provided the sphincter has been dilated up to 9 mm. in size, the T-tube may be removed at the end of twelve days. This has usually resulted in the cessation of all drainage of bile in seventeen to eighteen days and the discharge of the patient from the hospital within three weeks. When, on the other hand, the common and hepatic ducts are obviously dilated and obviously infected, with probable dilatation of the biliary tree within the substance of the liver, the T-tube is then left in place for two months. The patients are sent home with the T-tube in place; they are instructed to tie the tube with a piece of string and angulate it during the daytime in order not to soil their clothes, but to place the end of the tube in a bottle and to allow it to drain throughout the night. At the end of two months they are instructed to come to the clinic and the drain is withdrawn without administering an anesthetic. We have never had a rubber tube break, necessitating reoperation for the portion of tube left within the abdomen. We have never had one of the external biliary fistulas fail to close. Following the removal of a T-tube at the end of two months, most of the remaining fistulas cease discharging bile within a week. We believe that the prolonged decompression of the biliary tree for a period of two months, particularly in cases in which the ducts are infected and dilated, is of distinct value in ridding the biliary tree of infection.

#### CONCLUSIONS

Earlier operation upon patients for gallstones would cut down the number of patients in whom common duct stones are now found, and this is the logical approach to improve the results of surgery for cholelithiasis. Many patients have in the past and are still having gall-bladders removed and common duct stones left behind.

If we wish to remove all of the stones in the gall-bladder and biliary tract, the common and hepatic ducts must be

explored in approximately 50 per cent of the cases and in approximately half of these cases stones will not be found.

The condition of the wall of the gall-bladder and the character of the bile within it are valuable criteria as to whether or not the common and hepatic ducts should be opened and explored.

Inspection of bile in a hypodermic syringe by transmitted light gives excellent evidence as to the probable presence of infection or stones within the main bile ducts and the need for their exploration and drainage.

Technical measures are discussed which have to do with the safety of the operation

and with the length of post-operative drainage.

Finally, no operation for gallstones offers the patient the highest percentage of relief of symptoms, the lowest percentage of complications and the lowest ultimate mortality unless it not only removes the stones within the gall-bladder and the gall-bladder itself, but also assures the surgeon and the patient that any possible stones within the common and hepatic ducts have also been removed, and that that structure is, to the greatest possible extent, relieved of its associated infection by drainage.



VERY occasionally a compound volvulus is seen in which two coils of bowel are twisted and intertwined with each other. The condition occurs most commonly in the pelvic colon, and is occasionally seen in the caecum or small intestines.

From—"The Science and Practice of Surgery" by W. H. C. Romaines and Philip H. Mitchiner, 6th Ed. (Churchill).

# INJURIES TO THE EXTRAHEPATIC BILE DUCTS

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**R**ARELY are injuries to any structure attended by such distressing and serious complications as are injuries to the extrahepatic bile ducts. In a high percentage of cases the process of healing results in scar formation, which, by contraction, encroaches upon the lumen of the bile duct and thus interferes with hepatic function directly by mechanical obstruction and indirectly by parenchymal damage. In such instances, whether or not there is an associated biliary fistula, it becomes necessary to establish adequate biliary flow by surgical means. Perhaps in no other field of abdominal surgery is there greater need for sound surgical judgment and technical skill.

## ETIOLOGY OF STRICTURE OF THE EXTRAHEPATIC BILE DUCTS

Injuries to the extrahepatic bile ducts occur most frequently during the course of cholecystectomy. Such a catastrophe can be avoided in the majority of instances through the exercise of proper care in isolating and visualizing the distal portion of the common hepatic bile duct and the proximal portion of the common bile duct before sectioning the cystic duct. Because of the many anatomic variations which occur in this region, and because the tissues not infrequently are greatly distorted by inflammatory reaction, damage to the extrahepatic ducts may be imposed even by the most expert operator.

Contrary to the impression which is held generally, injury occurs more frequently when the operative procedure is relatively simple than when exposure is made difficult by a high-lying liver, or by a severe degree of inflammation in the gall-bladder or in the extracholecystic or extracholedochal

tissues. When adequate exposure is accomplished without difficulty, all of the tissues are relatively mobile and the common bile duct may become angulated by traction on the gall-bladder. Unless great care is exercised under such circumstances, a small portion of the wall of the common bile duct at the apex of the angulated area may be included in the clamp that has been placed on the distal end of the cystic duct. (Fig. 1A.) Further encroachment upon the lumen of the duct will result when this area is ligated. The fact has been stressed repeatedly that it is not necessary to remove the entire cystic duct during cholecystectomy. Not infrequently a stone may become impacted in the cystic duct so close to the common duct that it is impossible from a technical standpoint to divide the cystic duct distal to the stone without injuring the common bile duct. In this situation, and if there is any doubt as to the presence of a retained stone or stones in the distal portion of the cystic duct, it is safer to section the duct proximal to the suspected area and to explore thoroughly the distal segment before ligation.

Large carcinomas of the stomach, near the pylorus and with extension and induration into the duodenum and posteriorly into the pancreas, may distort the normal anatomic arrangement to such an extent that the distal portion of the common bile duct may be damaged in performing a difficult resection of the malignant mass. The assumption that a growth in the stomach is inoperable, if there is any possibility of injury to the duct, may deprive the patient of the one chance of recovery.

Injury to the extrahepatic bile ducts may occur in attempting to place a

hemostat on the cystic artery from which the ligature has become detached, or which has been divided inadvertently. Visualiza-

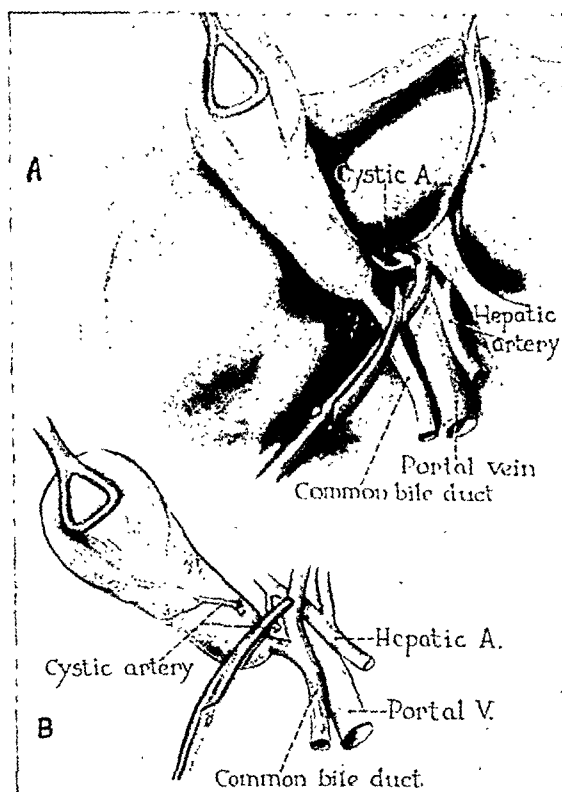


FIG. 1. A, when traction is made on the gall-bladder, the common duct may be angulated and traumatized in placing a hemostat from the lower end of the cystic duct. B, the right hepatic duct may be injured by blind instrumentation in attempting to control bleeding from the cystic artery.

tion of the bleeding point is immediately obliterated by the profuse hemorrhage, and an attempt is frequently made to control the bleeding by blind instrumentation, thus jeopardizing the common bile duct. (Fig. 1B.) The right hepatic duct is likely to be traumatized under such circumstances. By applying slight pressure to the hepatic artery, bleeding can be controlled and accurate application of a hemostat to the bleeding point made possible. Exposure is essential if cholecystectomy is to be performed with the greatest facility. After the stomach has been gently packed mesially, and the hepatic flexure of the colon mesially and caudally, the first assistant should utilize his left hand in

such a manner as to straddle the lateral border of the duodenohepatic ligament with the index and third fingers. In this manner, gentle traction may be applied to the common bile duct. (Fig. 2.) Should it become necessary to control bleeding from the cystic artery, the index and third fingers may be inserted readily through the foramen of Winslow and pressure applied to the hepatic artery between these two fingers and the thumb. (Fig. 2 insert.)

Judd<sup>19</sup> was impressed by the fact that, in a relatively large number of cases, no suggestion of stricture developed for many months, and in some instances for several years, after cholecystectomy. He had noted other cases in which there was clinical evidence of intermittent obstruction of the duct before any operation was performed. Similar experiences have been reported by others. Because of these observations Judd was of the opinion that an *obliterative inflammatory process* throughout the ducts was the real cause of many of the strictures attributed to trauma. That a certain number of strictures may result from a severe inflammatory reaction in the ducts when no stones have been present is unquestioned, but the number must be relatively small as the process under such circumstances is apt to be more diffuse than that which would produce the localized areas of stricture seen in the majority of cases. Presumptive evidence would incriminate stones in some instances as a contributing traumatic factor in the production of stricture. The incidence of such an etiologic factor cannot be determined. In rare instances, the extrahepatic bile ducts may be injured by trauma from without.

#### HEPATIC DAMAGE RESULTING FROM PARTIAL OR COMPLETE OBSTRUCTION OF THE EXTRAHEPATIC BILE DUCTS

When the ducts of any secreting gland are obstructed, stasis, dilatation of the ducts, and parenchymatous changes follow,

which are due in part to circulatory disturbances and infection. The term "hydrohepatosis" has been applied to this

seller and McIndoe<sup>9</sup> have noted a remarkable difference in the various grades and types of hydrohepatosis. By means

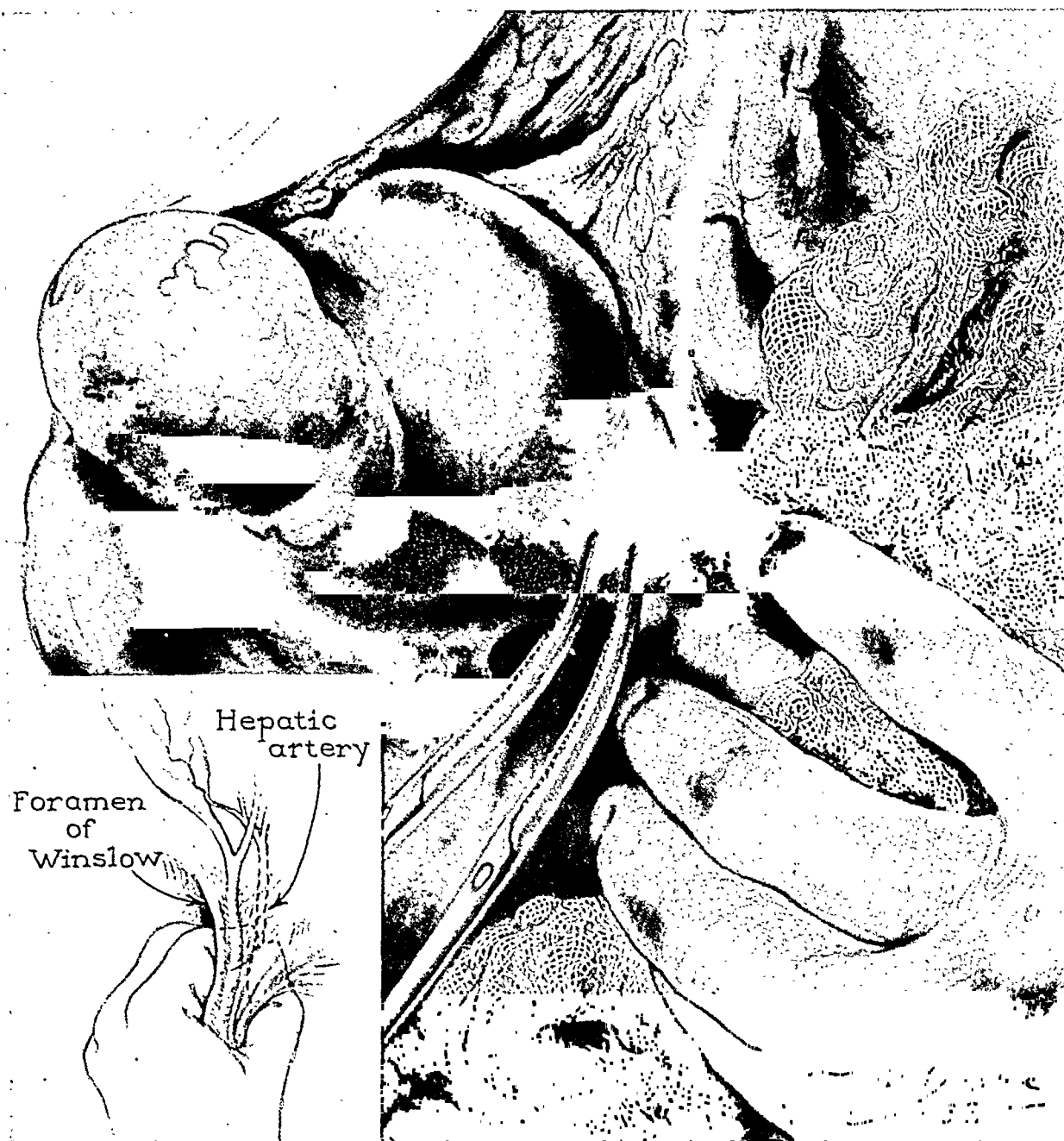


FIG. 2. In order to obtain satisfactory exposure, the stomach has been gently packed mesially and the hepatic flexure of the colon mesially and caudally. The left hand of the first assistant is utilized in such a manner as to straddle the lateral border of the duodenohepatic ligament with the index and third fingers. INSERT, the index and third fingers have been inserted through the foramen of Winslow and pressure applied to the hepatic artery by these two fingers and the thumb in order to control bleeding from the cystic artery.

condition when obstructive processes of the bile ducts result in dilatation of the biliary tree. The term "cholangiectasis" is more descriptive and consistent with similar processes in other organs. Coun-

of a celloidin injection-corrosion method, these investigators found that, of the conditions producing severe hydrohepatosis, one of the most important is stricture of the common bile duct.



Dilatation of the biliary tree would be of little significance if it were not for the severe parenchymal damage that alters the normal physiologic processes of the liver. The important physiologic activities of the liver may be summarized as follows:

1. Carbohydrate metabolism, the liver apparently being the sole regulating mechanism for maintenance of the level of blood sugar.<sup>23</sup>

2. Protein metabolism, the liver apparently being essential for the deamination of amino acids,<sup>2,3</sup> for the synthesis of urea, and for the destruction of uric acid.<sup>3</sup>

3. Bile metabolism, bile acids being formed directly in the hepatic cells.<sup>18</sup> The liver is evidently simply an organ of excretion for bile pigment<sup>24</sup> and appears to have the ability of converting indirect-reacting bilirubin, that is, to the Van den Bergh reagent, formed elsewhere in the body, to direct-reacting bilirubin, in which form it is excreted in the bile.<sup>1</sup> The metabolism of cholesterol and lecithin is not thoroughly understood.

4. Detoxication.<sup>27</sup>

5. Maintenance of blood protein. Fibrinogen evidently is produced exclusively in the liver. There are evidently definite, potent, hemoglobin-producing factors within the liver,<sup>35</sup> and a reserve of protein-building material in the liver probably figures prominently in a dynamic equilibrium between tissue protein and plasma protein.<sup>16</sup>

6. Vitamin metabolism, the exact rôle of the liver in this respect never having been demonstrated definitely.

It is surprising that general metabolic processes of such importance in the liver are not greatly altered even when appreciable hepatic damage has been effected. The important alterations in function following injury to the liver may be summarized as follows:

1. Carbohydrate metabolism. In studying the effects of calculous biliary obstruction of the bile ducts, which essentially is similar to that following stricture of the bile ducts, Snell<sup>29</sup> noted that there may

be an increased excretion of galactose in the occasional case with acute cellular damage and that hypoglycemia may occur among patients who have extremely fatty, cirrhotic livers.

2. Protein metabolism. With the exception of changes in the level of plasma proteins, Snell, Vanzant, and Judd<sup>31</sup> did not observe any significant alteration in protein metabolism as a complication or sequela of prolonged obstructive jaundice.

3. Bile metabolism.<sup>12,13</sup> Recently, a clinical study was made of the quantity of bile acids in the bile under various circumstances, and it was found that the ability of the liver to concentrate bile acids in the bile varied directly with the amount of hepatic damage present. If excretion of bile pigments is prevented by obstruction of the biliary ducts or by parenchymatous injury to the hepatic cell so that bilirubin is unable to pass through these cells, it is reabsorbed by the lymph and blood in the form which gives the direct van den Bergh reaction.<sup>1</sup> The effect of hepatic damage upon the metabolism of cholesterol and lecithin is not thoroughly understood.

4. Detoxication. It has repeatedly been demonstrated that the degree of intoxication resulting from the administration of various drugs varies directly with the extent of hepatic damage. A clinical test of liver function is based upon the inability of a damaged liver to conjugate benzoic acid with glycine to form hippuric acid.

5. Maintenance of blood protein. In the presence of parenchymatous lesions of the liver, disturbances in the equilibrium between tissue protein and plasma protein are often manifested by a reduction of the total protein and a reversal of the albumin-globulin ratio.<sup>16</sup> Frequently there is also a fall in the colloid osmotic pressure of the blood serum. Disturbances in the hemoglobin-producing factors within the liver may account for the macrocytic type of anemia which is not infrequently associated with severe hepatic injury.

6. Vitamin metabolism. There has been some suggestion that the fat soluble, and perhaps the water soluble, vitamins will be utilized poorly, if at all, when bile does not enter the intestine. Recently accumulated evidence suggests that the defect in the mechanism of coagulation lies in the formation of prothrombin and that the deficiency of prothrombin is associated with a deficiency of certain sterols, which have been designated tentatively as "vitamin K." By the administration of vitamin K, Snell and Butt<sup>30</sup> have attempted to control the bleeding tendency of patients whose livers have been severely injured. This study will soon have been advanced sufficiently for a preliminary report.

The seriousness of complete biliary fistula is well recognized. Although the liver has been spared the same degree of trauma that occurs when obstructive phenomena predominate, the loss of fluid and other constituents of the bile must be corrected without delay in order to avoid serious general complications. Not infrequently, both jaundice and a fistula will be manifest at the same time or intermittently, so the patient's condition is complicated by severe hepatic damage and the loss of these essential substances. In any event, the problem is to reestablish biliary flow as rapidly, and in a manner as nearly normal as possible.

#### OPERATIVE PROCEDURES

It is not the purpose of this paper to discuss in detail the various operative procedures which have been used to overcome the effects of stricture of the extrahepatic bile ducts. Familiarity with the operations described in many excellent reports is essential, however, if one is to deal satisfactorily with the individual problem as it is presented. W. J. Mayo described the first successful hepatoduodenostomy in 1905. Of many works to appear since then, the reader is referred for more detailed information to articles by Carter,<sup>4</sup> Christopher,<sup>5</sup> Clute,<sup>6</sup> Coors,<sup>7</sup>

Couch,<sup>8</sup> Eliot,<sup>10</sup> Friedman,<sup>11</sup> Herff,<sup>14</sup> Hoag,<sup>15</sup> Horgan,<sup>17</sup> Judd and his co-workers<sup>20,21</sup> Lahey,<sup>22</sup> Miller,<sup>26</sup> Ransom,<sup>28</sup> and Walters.<sup>32,33,34</sup>

#### SUMMARY AND COMMENT

In an attempt to discuss injuries to the extrahepatic bile ducts, it has been difficult to approach the subject in a different manner. Consideration has been given to the etiology of benign stricture and the pathologic physiology of the liver in order to emphasize the serious consequences of injury to the extrahepatic bile ducts. The distressing features of this condition may be emphasized further when it is considered that of 228 patients with stricture of the extrahepatic bile ducts who were operated on at The Mayo Clinic in the twenty-year period from 1917 to 1936, inclusive, 175 (76.7 per cent) were women. Seventy-three (32.0 per cent) of the total number of patients with stricture were in the fourth decade, and sixty-four (28.1 per cent) in the third decade of life. Eighteen (7.9 per cent) were less than thirty years of age. In other words, of ten patients with stricture of the extrahepatic bile ducts, seven will be less than fifty years of age. Practically all of the patients in whom strictures occurred had been operated on previously for disease of the biliary tract. Although operative trauma may have no relation to the production of the stricture in some instances, it is certain that the incidence of stricture of the extrahepatic ducts can be reduced if meticulous care is exercised in performing any operation on the biliary tract.

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# A CRITICAL EVALUATION OF CHOLANGIOGRAPHY\*

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UP to 1932 when Mirizzi<sup>1</sup> first suggested choangiography during operation, post-operative cholangiography had already acquired some vogue.<sup>2,3,4,5,6,7,9</sup> In 1936, Robbins and Hermanson<sup>8</sup> suggested the use of hippuran in place of lipiodol for visualizing the ducts during operation and stressed the point that unnecessary choledochostomy could be avoided if a normal cholangiogram was obtained before opening the duct.

Until recently the incidence of choledochostomy in operations upon the biliary tract has been between 8 and 16 per cent of all cases. Recognition of the pitfalls resulting from neglect to open the common duct has led to the performance of this procedure in 30 to 50 per cent of all cases in large surgical clinics at the present time. Insofar as the greater number of negative explorations of the common duct, which are necessarily occasioned by this practice, contributes to a higher morbidity and mortality, they should be avoided. The use of a reliable graphic method during the operation to check the criteria for choledochostomy should help to achieve this objective.

The purpose of this paper is to offer an appraisal of cholangiography on the basis of our experience with 105 cases. We propose to evaluate the method when utilized (1) during operation, and (2) post-operatively. Its advantages in the first instance are twofold: (a) when applied before opening the common duct it facilitates a decision in doubtful cases as to whether or not to open the duct; and (b) when applied after opening the duct, it acts as a check on the success or failure of the operator in the

eradication of whatever pathology may have been present.

The technique of the procedure in the post-operative patient is simple enough and requires no special comment. However, we should like to point out that although no serious sequelae need be anticipated, a small percentage of patients may be disturbed for several days by some fever and minor local discomfort.

Certain features of the technique during operation, however, are worth some notice. It is preferable, whenever possible, to inject the hippuran into the cystic rather than the common duct in order to avoid leakage through the needle hole. The escape of hippuran before or during exposure to the x-ray film may obscure the picture, and the subsequent drainage of bile may necessitate drainage when this might otherwise not have been necessary. The cystic duct is therefore ligated, and through an opening below the tie, a cannula or a ureteral catheter is inserted. This is tied in to prevent escape of the hippuran, which is then slowly introduced. If the cystic duct is occluded, or must be preserved with the gall-bladder for sidetracking purposes, or if there is danger of forcing small stones present in its lumen into the common duct, direct injection into the latter is the only alternative. For this purpose a narrow gauge, short-beveled, angulated tonsil needle is satisfactory, although even if the duct is not opened subsequently, the wound may need to be drained because leakage will occur even from the tiny hole produced by this needle. The cholangiogram requires six minutes for completion, during which time the gall-bladder may be re-

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moved. If the film shows a disturbance requiring choledochostomy, a second film is taken when the exploration is completed

taken without opening the ducts. Table 1 shows the pathology present in these patients.



FIG. 1. Normal immediate cholangiogram. Note narrow width and regular contour of the common duct. The intrahepatic canaliculi are not visualized. The ampulla is regular. The duodenum is well-filled with dye.



FIG. 2. R. K. Immediate cholangiogram taken before the common duct was opened. CD, clamp on the cystic duct. GB, clamp on the gall-bladder. The common duct is dilated. The intrahepatic canaliculi are dilated and blunted. The arrows point to two areas of diminished density typical of stone. The lower one is at the ampulla, which is irregular and blocked. The dye has not entered the duodenum. The stones were recovered at exploration of the common duct.

to see if the disturbance found has been dealt with successfully.

#### RESULTS IN IMMEDIATE CHOLANGIOGRAPHY

Of the 105 patients studied, thirty-nine showed normal cholangiograms which were

Cholecystectomy was done in all instances, but choledochostomy was not done. Subsequent experience with this group has demonstrated that the interpretation of the cholangiogram was presumably correct in thirty-seven. In two patients, however, who had numerous small, faceted stones in the gall-bladder, the post-operative course has been marked by repeated attacks of biliary colic, nausea and vomiting, but without jaundice. It is, therefore, proper to assume that stones were probably present in the common duct at the time the cholangiogram was taken. Consequently it appears that a normal cholangiogram, though reliable in most instances, is not infallible when small stones or bile sand are present in the common

TABLE 1

Lesions	No. of Patients
Chronic cholecystitis and cholelithiasis	26
Chronic cholecystitis and hepatic duct stones	1
Chronic cholecystitis	1
Subacute cholecystitis and cholelithiasis	2
Acute cholecystitis and cholelithiasis	1
Chronic cholecystitis and cholelithiasis, with gallbladder carcinoma	1
Chronic cholecystitis and cholelithiasis, with gallbladder carcinoma	1
Chronic cholecystitis and cholelithiasis, with gallbladder carcinoma	1
Total	39

duct. The following abstract illustrates the danger of too great confidence in an x-ray diagnosis by cholangiogram of a normal biliary tract:

A woman of 42 with a history of recurrent attacks of left upper quadrant pain of one year's duration was admitted with jaundice and tenderness in the right upper quadrant with radiation on pressure to the left upper quadrant and the angle of the left scapula. Following a positive Graham test, exploration disclosed a thin walled gall-bladder containing many small and a few large stones. The common duct was not thickened or dilated. Muddy bile was aspirated from it and a cholangiogram done with the following findings: The common and hepatic ducts were well outlined and of about normal caliber. There was no evidence of obstruction or irregularities to suggest stones. Nevertheless, because of the history and the other indications, choledochostomy was done and a number of small stones were removed from the lower end of the common duct.

In a group of twenty-one patients cholangiography was done before and after

opening the common duct. Table II lists the types of pathology found in these patients.



FIG. 3. Abnormal immediate cholangiogram showing spasm of the sphincter of Oddi. The common duct is moderately dilated. The intrahepatic canaliculi are dilated and blunted. The pancreatic duct is visualized. The ampulla is irregular and the dye has failed to enter the duodenum.

TABLE II

Lesions	No. of Patients
*Subacute cholecystitis, cholelithiasis, cholangitis.....	1
*Subacute cholecystitis, subacute cholangitis, pancreatitis.....	1
*Chronic cholecystitis, cholelithiasis, pancreatitis.....	1
*Chronic cholecystitis, chronic cholangitis.....	1
*Chronic cholecystitis, pericholangitis, focal hepatic necrosis.....	2
*Chronic cholecystitis, acute cholangitis.....	1
†Chronic cholecystitis, cholelithiasis, choledocholithiasis.....	4
Chronic cholecystitis, cholelithiasis...	3
Residual choledocholithiasis (post-cholecystectomy).....	4
Subacute cholecystitis, choledocholithiasis.....	2
Chronic cholecystitis, cholelithiasis, stricture common duct.....	1
Total.....	21

Two of the three cases with chronic cholecystitis and cholelithiasis had cholangiograms before opening the ducts, which were interpreted as showing obstruction at the ampulla. No organic disease in the duct was demonstrated. Cholangiogram after exploration of the duct demonstrated patency of the ampulla in one and in the other persisting obstruction was shown to be due to spasm only partially relieved by an antispasmodic. In eight of this group the cholangiogram preceding choledochostomy was interpreted as normal. In seven instances this was confirmed after opening the duct. Repeat cholangiograms were also normal. The eighth case is the one whose history is abstracted in the case report previously given and constitutes the only instance in which the x-ray diagnosis of

\* These patients showed a normal cholangiogram with confirmation of this diagnosis after choledochostomy.

† One of these patients showed a normal cholangiogram before choledochostomy, but stones were found when the duct was opened. This is the case referred to in the accompanying text.

normal cholangiogram was proved to be incorrect. If the two instances in the first group of thirty-nine patients, in whom an

cholangiogram substantiated the negative findings; the other was shown to be due to spasm which was only partially relieved



FIG. 4. S. C. Post-operative cholangiogram showing persistent spasm of the sphincter of Oddi. A, note the increased diameter and irregular contour of the common duct. Both hepatic ducts are dilated and the intrahepatic canaliculi are abnormally prominent. The ampulla is blunted and the dye has failed to enter the duodenum. B, after benzedrine and atropine. The common duct is somewhat smaller. The ampulla is patent and regular in contour. There is a free flow of dye into the duodenum.

error in interpretation is inferred from the post-operative history, are added to this one, there is a total of three errors in forty-seven cases in which an x-ray diagnosis was made of a normal biliary tree before opening the duct. The percentage of correct diagnoses was therefore 93.6 per cent, which is good evidence of the high degree of reliability of the method.

The remaining thirteen patients of this group were considered to have stone or obstruction or dilatation, or any combination of these, by cholangiography before the common duct was opened. The diagnosis was established as correct in eleven. Of the two which were incorrect, one showed no disease in the duct system and a repeat

by an antispasmodic. It is apparently not possible to distinguish by x-ray examination whether or not an obstruction at the ampulla is functional or organic unless stones can be visualized in the film. This was the case in three of the four patients in Table II who were operated upon for residual choledocholithiasis. When, therefore, an x-ray diagnosis of obstruction at the ampulla is made, spasm must be considered as a possible cause unless stones or a tumor are suggested by filling defects.

Because of insufficient data in some of the surgeons' operative notes, it is impossible, unfortunately, to state how often the cholangiogram taken before opening the duct revealed pathology which was not

anticipated by the history or by inspection or palpation of the ducts. That the x-ray diagnosis of stone must not be ignored is

first impression of stone above the ampulla. Further search was rewarded by removal of the stone. A check-up cholangiogram

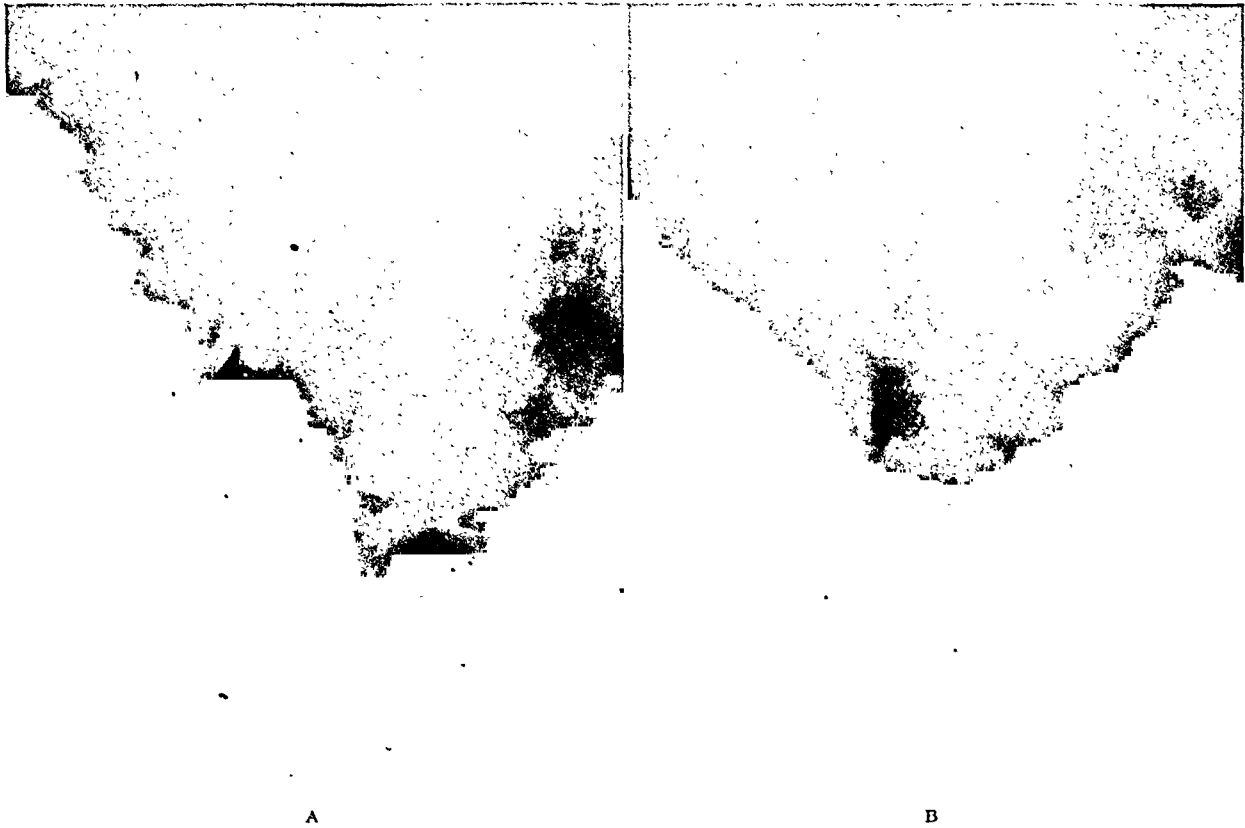


FIG. 5. E. L. Illustrating the effects of brief decompression of a common duct which had been obstructed by stone for a short period of time. A, immediate cholangiogram before the common duct was opened. Note the greatly dilated common duct which is visible alongside the clamp applied to the cystic duct. The ampulla is completely blocked and there is no dye in the duodenum. B, post-operative cholangiogram of same case, taken on the tenth post-operative day. The common duct is nearly normal in size. The ampulla is patent and regular, and there is a free flow of dye into the duodenum.

well illustrated in the following operative note: "Pre-operative diagnosis, cholelithiasis, ? choledocholithiasis. The gall-bladder was somewhat thickened . . . and filled with numerous stones, both large and small. The cystic duct was dilated and also contained stones. The common duct was not dilated and stones could not be palpated. It was felt, however, in view of the character of the stones in the gall-bladder and the dilatation with stones of the cystic duct, that the common duct should be explored. A needle was introduced and slightly muddy bile aspirated. Hippuran injected and a picture taken." The cholangiogram showed a stone in the common duct. "The common duct was then opened and explored. At first no stones could be found. Review of the film confirmed the

showed a normal biliary tree." The patient has remained well since operation two years ago.

Six patients in this group showed cholangitis or pericholangitis by gross inspection of the external biliary system or by biopsy of the liver. In none of them did the x-ray film show any variation from the normal so that it is safe to assume that cholangiography will not disclose this pathologic disturbance unless accompanied by long standing obstruction of the ducts from stone, infection or stricture.

In all but two of the twenty-one patients in this group, patency of the ducts and complete evacuation of the stones were confirmed by a repeat cholangiogram before terminating the operation. In the first of the two cases still showing stones



at the termination of operation, stones were found in the duct as predicted by the x-ray film taken before choledochostomy. After removal of the stones and the establishing of patency of the ampulla by a dilaprobe, a repeat cholangiogram showed no stone, but the hippuran did not enter the duodenum. In view of this finding further efforts to recover stones were unavailing. The first post-operative cholangiogram still showed a filling defect near the lower end of the T-tube and no hippuran in the duodenum. A second cholangiogram a week later did not show this filling defect and some hippuran entered the duodenum. The patient has remained well during the subsequent six months, but a final decision as to the accuracy of the x-ray interpretation in this case is not yet justified. In the second case the cholangiogram preceding choledochostomy showed stone, but none could be found after prolonged search. Although a repeat film still showed stone, the patient's condition required termination of the operation. The patient continued to have biliary colic and at a subsequent operation the stone was found and removed.

The post-operative course of these patients, except for the second case just cited, which varies from two months to four and a half years, has been uniformly uneventful. The assurance given to the surgeon by the check-up cholangiogram that the common duct has been restored as far as possible to normal constitutes a great advantage to the patient which has hitherto been unavailable.

A third group of fourteen patients had cholangiograms taken only after the common duct had been opened and explored. Of these, nine showed stones in the common duct and in eight the check-up x-ray showed a normal biliary tree. From the subsequent history the x-ray diagnosis was apparently correct in all but the ninth patient, who has continued to have symptoms characteristic of common duct obstruction. In this patient the x-ray at the termination of the operation indicated narrowing and irregularity above the

ampulla although a small amount of hippuran entered the duodenum. This patient has had recurrent colicky epigastric pain radiating straight through to the back, and sour eructations.

In the remaining five patients of group 3, no stones were found in the common duct. In three the cholangiograms were normal and in the fourth there was slight residual dilatation, but all four have been well since operation. The fifth patient had had a previous cholecystectomy and choledochostomy with the removal of stones from the duct. Recurrence of symptoms suggesting duct obstruction led to reoperation. The common duct was free of stones but markedly dilated. It was not possible to probe and stretch the ampulla. Cholangiography showed a distended common duct and patency of the ampulla at the end of the operation. Following a five month period of T-tube drainage with no evidence of decrease in the caliber of the duct, he was operated upon again with the same findings as in the previous exploration. Choledochoduodenostomy was done; the patient has remained free of symptoms for the three years since.

Our experience with this third group of patients is substantially the same as with the second group with respect to the reliability of the check-up cholangiogram, which was correct in thirteen out of fourteen patients, or 92.8 per cent.

#### POST-OPERATIVE CHOLANGIOGRAPHY

We have subjected seventy-six patients, whose common ducts were drained at operation, to cholangiography during convalescence and at varying intervals afterward when drainage was continued because of persisting abnormalities in the biliary ducts. Thirty-five of these were patients who had check-up cholangiograms during operation. The cholangiograms post-operatively did not differ from those taken at the end of the operation with the exception of the twentieth case in group 2 of the preceding section, in which persisting obstruction at the ampulla at the end of

the operation was later shown not to exist. Except for this case, the post-operative history of these patients has not in any instance contradicted the clinical result expected from the appearance of the ducts in the check-up cholangiogram taken at the end of the operation.

Forty-one patients whose common ducts were drained, but who had not had cholangiography during operation, have been examined post-operatively. Of these, twenty-three showed a normal biliary tree but two of these continued to have biliary colic. One proved to have a stone at a subsequent operation; the other has not been explored. Eight cases showed a dilated but patent biliary tree and have remained symptom-free. The remaining eleven showed stones and in three this was confirmed by a later operation. A fourth did not show stones at a later operation. Three others showing stones have continued to have biliary colic but have not been operated upon again. Of four patients who showed obstruction at the ampulla, with restoration of the ducts to normal upon the administration of antispasmodics, two continue to have biliary colic, while the other two are symptom-free. One of the latter is only two months post-operative, but the other has remained well a year afterward even though the post-operative cholangiogram before administration of the antispasmodic showed stones as well as spasm.

The diagnostic accuracy of post-operative cholangiography appears from this group of patients to be 94.7 per cent (four errors in seventy-six cases), which is equal to its accuracy when done during operation.

#### DISCUSSION

A review of the data in the forty-one patients who had only post-operative cholangiography shows that at least three and possibly eight of the eleven with persisting biliary colic may be considered to have a residual stone with or without obstruction. Three of the eight have required a second operation and some of the

remainder will probably have to be re-operated. These figures indicate that as many as 19.5 per cent of common duct cases will need reoperation if the surgeon fails to avail himself of the guidance which a check-up cholangiogram provides in a decision as to whether or not the disturbance in the duct has been eradicated before terminating the operation. For it is clear that in those patients who did have check-up cholangiograms before closure, only one needed reoperation and in this case it was not because the cholangiogram was misleading, but because the patient could not tolerate continued operative manipulation.

Correct x-ray interpretation of the status of the biliary tree requires a clear understanding of the types of deformity in the x-ray outlines of the ducts produced by the various pathologic conditions which may be encountered. The commonest variation from the normal is dilatation, which is presumptive evidence of obstruction, although it may exist in long standing cases of infection without organic block. If, under these circumstances, the hippuran enters the duodenum freely, one is not necessarily obliged to persist in a search for stone. Dilatation with complete block at the ampulla is generally due to stone or tumor. If in addition a filling defect is visible anywhere in the duct system the probability of stone or tumor becomes almost a certainty. In the absence of a filling defect the block at the ampulla may be due to spasm rather than stone. The frequency with which this has been observed makes it imperative, if an adequate search for stone has proved fruitless, to determine the presence or absence of spasm by repeating the film after the administration of an antispasmodic. It is important in this connection to be certain that the hippuran enters the duodenum with ease.

Cholangitis will ordinarily not be demonstrable on the film except in advanced stages where gross distortion exists from edema, fibrosis or stricture.

Perplexities as to patency of the ampulla have arisen during operation and post-operatively when the hippuran merely trickled through. Another cholangiogram may be needed to resolve this doubt, and does not in our experience add appreciably to the patient's burden.

In our aim to emphasize the advantages of cholangiography during operation, we wish to make it clear that we do not practice or recommend its use in all operations on the biliary tract. We do not consider it necessary in the routine case of acute or chronic cholecystitis, or even when one or more large stones are present in the gall-bladder, unless the history suggests a coexistent involvement of the biliary ducts. However, whenever the matter of opening the ducts is debatable, the issue can be satisfactorily settled by a preliminary cholangiogram. For example, when a patient has a history of slight transient jaundice and at operation the common duct and head of the pancreas are normal to palpation and clear bile is aspirated from the duct, if the cholangiogram shows an undilated biliary system with no filling defect, a normal ampulla and a copious discharge of hippuran into the duodenum, assurance is given that choledochostomy is unnecessary. We wish, however, to qualify this general rule whenever the gall-bladder contains small stones or when muddy bile is aspirated from the common duct. It is in these circumstances that the only two errors were made in thirty-nine instances in which preliminary cholangiograms reported normal findings.

On the other hand, a positive x-ray diagnosis of disease in the biliary ducts can be confidently relied upon as an indication for choledochostomy because of the accuracy of the diagnosis in all but one of the thirty-five cases. In this exceptional case, as already stated, the error was accountable on the basis of spasm. When the indication for choledochostomy is clear-cut, a preliminary cholangiogram is superfluous.

We would, however, strongly urge the routine use of check-up cholangiograms if

the common duct has been opened and stones or other disturbances have been found. If a preliminary cholangiogram gives evidence of disease, a check-up cholangiogram is likewise desirable whether or not the disease is found. We consider from our experience that no other method available can give us as strong assurance that we are leaving the ducts as free of disease as possible when the operation is completed.

The usefulness of post-operative cholangiography has been thoroughly demonstrated in the literature. We are in complete agreement with those who utilize it for the purpose of determining when the proper time has arrived for removal of the drainage tube. Formerly, without cholangiography, the interruption of drainage has been determined rather arbitrarily. The x-ray film, by indicating the degree of patency of the ampulla, the extent of dilatation of the ducts and the presence or absence of residual stones, provides a more precise index as to the necessary period of post-operative drainage and the likelihood of possible future surgery.

#### SUMMARY AND CONCLUSIONS

1. From a study of cholangiography in 105 patients, it is clear that this procedure offers a valuable guide in debatable cases of common duct disease as to whether or not the duct should be opened for exploration.

2. A normal cholangiogram preceding choledochostomy is a trustworthy indication for avoiding choledochostomy except when the gall-bladder contains small stones or unless the common duct contains muddy bile or needs drainage because of cholangitis.

3. If the history or examination of the ducts at operation is sufficient to indicate choledochostomy, a preliminary cholangiogram is unnecessary.

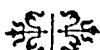
4. Once the ducts have been opened because of pathology suggested by the history, appearance of the ducts or by a preliminary cholangiogram, check-up cholangiograms are strongly recommended in

order to make certain that the ducts have been restored to normal as far as possible. The importance of this procedure is emphasized by the failure successfully to eradicate stones or obstruction in the ducts in an estimated maximum of 19.5 per cent of those cases in which only post-operative cholangiography was done.

5. Cholangiography has proved to be accurate in about 94 per cent of all cases whether it was done during operation or post-operatively.

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CARCINOMA of the gall-bladder is much more frequent than is generally supposed. . . . There are no characteristic symptoms or signs. When the neoplasm is confined the gall-bladder, cholecystectomy offers considerable hope of a cure.

From—"A Short Practice of Surgery" by Hamilton Bailey and R. J. McNeill Love (Lewis).

# SURGERY OF THE BILIARY TRACT IN INFANTS AND CHILDREN\*

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IT is generally known that diseases of the biliary tract in infants and children are rare. This has been our experience at the Children's Hospital of Michigan, and review of the literature confirms this fact.

There are many factors which predispose to biliary tract disease in children, the most important of which are, as stated by Potter,<sup>1</sup> influenza, appendicitis, scarlet fever, diphtheria, and rarely today, typhoid fever. It has not been our experience over a period of years to observe biliary or acute gall-bladder disease complicating the acute exanthemata. Infections in the digestive tract must be considered as one of the most probable etiologic factors in infections of the gall-bladder. Stagnation of bile in the gall-bladder predisposes to infection. In considering diseases of the biliary tract, and especially in infants and children who are jaundiced, a careful study of the history, physical and laboratory findings is essential in evaluating the true pathologic condition.

## CONGENITAL OBSTRUCTION OF THE BILE DUCTS

In an excellent review of this subject by Ladd,<sup>2</sup> in which forty-five cases are discussed, one is impressed by the fact that this condition must be considered in making a differential diagnosis of jaundice in the young infant. In infants with a congenital obstruction of the bile ducts, jaundice appears a few days after birth and gradually increases. At the end of two or three weeks, the skin has a greenish-yellow appearance, the liver is usually enlarged

and the stools acholic. According to Ladd, there are variations in anomalies of congenital obstruction of the bile duct, classified as follows:

1. Absence of the extrahepatic ducts.
2. Atresia of the hepatic ducts.
3. Atresia of the common duct.
4. The gall-bladder is represented by a moderate sized cyst not connected with the common duct. There may or may not be any common or hepatic ducts.
5. The gall-bladder connects directly with the duodenum but there are no other extrahepatic ducts. That is, no ducts connect the liver and gall-bladder or the liver and intestine.
6. Stenosis of the common duct plugged with inspissated bile, causing complete obstruction.
7. Narrowing of the common duct causing partial obstruction.

In an infant in whom there exists the strong possibility of a congenital obstruction of the bile ducts, the prognosis without surgery is hopeless. It is imperative that these patients be explored surgically with the hope of relieving the obstruction. The method of surgical procedure in relieving the obstruction will vary with the type of anomaly causing the obstruction. Common duct obstruction has been relieved in our cases by anastomosing the gall-bladder to the duodenum, as the following case will show:

E. G., a white male infant, 2 months of age, was admitted to the hospital June 26, 1936, with a history of having been jaundiced since

\* From the Surgical Service of the Children's Hospital of Michigan.

birth. The stools were reported as being clay-colored, and the urine a dark amber. The essential physical findings were: (1) sclera and skin greenish-yellow; (2) liver edge palpated two fingerbreadths below the costal margin; (3) spleen palpated one fingerbreadth below the costal margin. Laboratory studies revealed: hemoglobin 11.5 Gm.; red blood count 4,200,000; icteric index ranged from 25 to 37.5 before operation; and the urine was positive for bile.

On July 8, 1936 an exploratory laparotomy was performed through a high right paramedian incision. The gall-bladder was elongated and distended. On aspiration, clear yellow fluid was obtained. The gall-bladder was opened, and it was found impossible to pass a probe down the common duct to the ampulla of Vater, because of an obstruction. A cholecystoduodenostomy was performed, using fine silk sutures.

The infant made an uneventful recovery. The jaundice disappeared entirely within two weeks, and on July 27, 1936 the icteric index was 6. The child was again seen on January 13, 1937 at which time his appetite was good, and there was no jaundice.

The following case will illustrate an obstruction of the common bile duct due to inspissated bile:

V. G., a white female infant, 8 months of age, was admitted to the hospital October 25, 1928 with a history of vomiting and jaundice of two weeks' duration. The temperature was 101 degrees, pulse 120, and respirations 30. The essential physical findings were: (1) sclera and skin were markedly icteric; (2) liver edge palpable two fingerbreadths below the costal margin. Laboratory findings revealed: hemoglobin 62 per cent; red blood count 4,300,000; white blood count 16,200, with 44 per cent polys, 52 lymphocytes and 4 eosinophiles. The icteric index was 23, the urine positive for bile, and the direct and indirect Van den Bergh were both strongly positive.

The child was transfused before operation, and on November 11, 1928, an exploratory laparotomy was performed under general anesthesia. The abdomen was opened through a high right paramedian incision, the liver was found to extend down to the crest of the ilium, and was classified grossly as a hydrops. The gall-bladder was found to be distended, and on

aspiration dark bile-stained fluid was obtained. The cystic duct was probed, and found to be patent, as was that portion of the common duct near the junction with the cystic duct. A catheter was inserted in the gall-bladder, anchored, and partially inverted by a purse string suture. Saline was injected into the catheter and irrigation was attempted, but due to an obstruction in the common bile duct, this was unsuccessful for the moment. Subsequent attempts at forcing fluid through by irrigation with saline were carried on under slight pressure, and suddenly the obstruction was relieved. From the sequence of the foregoing events, it was apparent that there was an obstruction of the common bile duct due to a plug of inspissated bile.

The infant made a good recovery, except for a complicating pneumonic process of the right upper lobe and an otitis media. On December 8, 1928, or four weeks after operation, the icteric index was 5, and the child was discharged from the hospital with no apparent jaundice. The liver had receded to its normal size.

#### CHOLECYSTITIS

Acute cholecystitis is rarely seen in infants, but it is occasionally seen in older children, especially as a complication of some preceding infection such as scarlet fever, diphtheria, influenza or typhoid fever. Gangrenous cholecystitis has been reported complicating scarlet fever, and when seen, demands prompt surgical intervention. Reid and Montgomery<sup>3</sup> reported cases of cholecystitis complicating typhoid fever, and emphasized the need for surgical intervention if there was a suspicion of a possible empyema of the gall-bladder. In eighteen cases under fifteen years of age, which these authors found in the literature, ten were subjected to surgery with a mortality of 10 per cent, while eight who were treated expectantly suffered a mortality of 100 per cent. They reported an additional case of acute suppurative cholecystitis complicating a typhoid fever infection. A cholecystectomy was performed and the child made a good recovery. Reid and Montgomery emphasize the importance of differentiating between the gall-

bladder complications that do, and those that do not, require surgical treatment. The authors stress the need for surgical treatment in acute suppurative typhoidal cholecystitis, for in such cases, perforation of the gall-bladder may occur and thus lessen the chances for recovery.

Acute cholecystitis in infants and children necessitating surgery has not been seen in our clinic, but we have operated on patients classified as subacute cholecystitis. The specimens removed at the time of operation and examined microscopically in these cases confirmed the diagnosis. The following cases will illustrate this condition:

H. B., a white female of 11 years, was admitted to the hospital on December 5, 1932 with a history of having been well until six weeks prior to admission, at which time her mother noticed that she was pale and languid. She complained of epigastric and right upper quadrant pain, occasionally colicky in type, and often radiating through to the back. Jaundice was present for three weeks, and increased in intensity up to the time of admission.

The essential physical findings were: (1) sclera and skin markedly icteric; (2) tenderness in the right upper quadrant with slight muscle spasm; (3) liver palpable one and a half fingerbreadths below the costal margin. The temperature was normal, the pulse 110, respirations 15. Laboratory studies showed the following: urine positive for bile; stools acholic; hemoglobin 14.2 per cent; red blood count 4,250,000; white blood count 10,500, with 80 per cent polys and 20 per cent lymphocytes, the blood fragility test normal; the icteric index 21; and the direct and indirect Van den Bergh markedly positive. On December 7, 1932, or two days after admission, a flat plate of the abdomen showed the liver slightly enlarged, but no other evidence of abnormality.

The child was treated expectantly with no improvement. She was then transfused, and an exploratory laparotomy performed December 17, 1932. The liver was found to extend two fingerbreadths below the costal margin, and it was smooth and normal in color. The gall-bladder was distended, and the wall thickened. Aspiration of the gall-bladder contents revealed clear amber fluid. A cholecystostomy was per-

formed, and a biopsy of the gall-bladder and liver taken.

Convalescence was uneventful, the jaundice having cleared on December 28th, eleven days post-operatively. The drainage tube was removed from the gall-bladder January 5, 1933. The child was discharged from the hospital on January 8, 1933. The pathologic diagnosis of the tissue removed was biliary cirrhosis, and subacute cholecystitis.

J. F., a white male, 10 years of age, was admitted to the hospital August 26, 1932 with a history of periodic attacks of mild jaundice associated with right upper quadrant pain and nausea for two years. These symptoms had their origin after a severe scarlet fever. The essential physical findings were: (1) sclera and skin markedly icteric; (2) liver palpable one fingerbreadth below the costal margin. Laboratory studies revealed: hemoglobin 15 Gm.; red blood count 5,100,000; urine positive for bile; stools acholic; non-protein nitrogen 34; icteric index 15; direct and indirect Van den Bergh both strongly positive; and blood fragility test normal.

On October 1, 1932 an exploratory laparotomy was performed. The gall-bladder was distended, the liver slightly enlarged with a greenish tinge, and the edge smooth. A cholecystostomy was performed. A biopsy of the gall-bladder wall and right lobe of the liver revealed a pathologic diagnosis of biliary cirrhosis and subacute cholecystitis.

The child made an uneventful recovery, the jaundice clearing and the tube being removed from the gall-bladder October 16, 1932. The patient was discharged from the hospital on October 31, 1932. He was seen subsequently March 19, 1934, at which time a Graham-Cole study was made of the gall-bladder function. It is of clinical interest to note that the gall bladder function was normal at this time.

Cholecystitis associated with cholelithiasis has been reported by a number of authors. Potter,<sup>1</sup> in 1928, collected 226 cases of gall-bladder disease in the very young which had been reported in the literature up to August 1927. In this group of 226 cases, 140 had gallstones present, and these patients were all under 15 years of age; 48 had no stones; in 38, stones were not mentioned; 44 had stones and cholecystitis; 59 showed cholecystitis; 93 had

cholecystitis but no stones were mentioned. Skemp<sup>4</sup> reported numerous stones present in the gall-bladder at post-mortem in an infant 17 months of age, the child having died from an extensive pneumonic process in the left lower lobe. The gall-bladder in this instance was not thickened. In those patients having a history suggestive of a chronic cholecystitis and cholelithiasis, the gall-bladder function should be studied by the Graham-Cole technique. In our experience at the Children's Hospital with patients who have repeated attacks of right upper quadrant pain, it has been a valuable aid in the differential diagnosis. No stones have been found in any of the cases of cholecystitis and biliary cirrhosis which we have operated upon. Surgical drainage of the biliary tract should be considered the treatment in cases so classified.

#### TYPES OF JAUNDICE FOUND IN INFANTS AND CHILDREN

Infants with jaundice must be carefully studied before any surgical procedure of the biliary tract is to be considered. The probable cause of the jaundice must be investigated. In the jaundice associated with *hemolytic sepsis*, the liver is usually enlarged, the stool is not acholic, and there is usually no bile in the urine. The icteric index is high and the jaundice is usually not progressive in type. The great majority of cases of jaundice in the newborn are of this type, and are secondary to a navel infection. *Congenital lues* with jaundice can easily be differentiated by the blood Wassermann or Kahn reaction of the mother and child and a roentgenologic examination of the skeletal system. *Icterus neonatorum* is characterized by the fact that an infant with this type of jaundice is usually not ill. The jaundice makes its appearance in about two to three days after birth, and disappears during the second week of life. There is no enlargement of the liver, no bile in the urine, and the stools are not acholic.

*Erythroblastosis fetalis* is a condition which has not received proper recognition as a distinct cause of jaundice. There has been some interest in the last few years in this disease, which was formerly known as *familial icterus gravis neonatorum*. The obstetrician should be particularly interested, because he has the first opportunity to recognize this disease in its earliest phase. It is a macrocytic, hemolytic anemia attended by an intense bilirubinemia and jaundice which develops within the first twenty-four hours after birth. The *familial feature* of this disease is an important factor in the diagnosis. Hemotologic studies reveal a high percentage of nucleated erythrocytes, the majority of which are normoblasts. The spleen and liver are enlarged, and on section, these and other depots of reticulo-endothelium reveal many areas of extramedullary hemopoiesis. In the cases which have recovered in the past, the great majority have been treated by multiple small transfusions, but the mortality has been high. One of us (G. C. P.) with Cooley<sup>6</sup> in 1935 reported a successful splenectomy in the treatment of this disease. The patient was 36 hours old, the second child in a family, in which the first had died on the fourth day after birth and was reported to have had severe jaundice. Before operation the icteric index was 300. The splenectomy was performed under local anesthesia. Nine days post-operatively the icteric index was 5 and the skin had regained its normal color. The convalescence was uneventful with no need for blood transfusions. At this date, according to the follow-up record, the child is in good health.

In older children with a tendency to jaundice, careful clinical and laboratory investigations are imperative, as there are other causes for jaundice foreign to the biliary tract. Hemolytic icterus<sup>5</sup> is the one condition that deserves scrutiny. It is in this condition that splenectomy has brought such startling results. The gall-bladder should be explored at the time of splenectomy, as cholelithiasis is occa-



sionally a concomitant finding. We have observed no recurrence of the jaundice after splenectomy for hemolytic icterus "hypersplenism."

#### SUMMARY

1. All infants and children with jaundice or having a history of repeated jaundice should be carefully investigated under the joint supervision of the pediatrician and surgeon.

2. Surgical exploration is indicated when jaundice is present and persists. The reported good results from surgery in this condition warrant more serious consideration than they apparently have received in the past.

3. In older children with persistent jaundice due to biliary tract disease, chole-

cystostomy and possible drainage of the common duct should be considered.

4. Cases of jaundice of extrahepatic origin after clinical and laboratory investigation, fall in a group which should be considered as requiring surgical intervention.

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TUMORS behind the liver, pushing it forward and down, are often overlooked, because they bring the liver so prominently into the foreground and fasten our attention on what is mistaken for an enlargement of the organ. Wherever the cause of a supposed enlargement of the liver is not obvious, retroperitoneal sarcoma or some other deep-seated tumor should be suspected.

From—"Physical Diagnosis" by Richard C. Cabot (William Wood).

# PREPARATION OF THE JAUNDICED PATIENT FOR OPERATION\*

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THE preparation of the jaundiced patient includes all of the precautionary and rehabilitative measures which should precede every major operation and in addition, an attempt must be made to meet the added hazard which is signalized by the symptom complex of jaundice.

A jaundiced patient is one whose blood plasma, tissues, skin, mucous membranes and sclerae are stained varied depths of color from light yellow to a greenish golden hue by retained bile pigment. The degree or depth of jaundice is not a reliable index of the severity of the underlying pathologic state. This fact must be appreciated thoroughly if one is to guard against the unhappy situations which frequently follow ill advised and poorly timed operations. Whatever may be the cause of the jaundice, the effect on the patient is produced by one or a combination of the following:<sup>1</sup> First, the retained bile in the blood and tissue fluids produces certain ill effects on the body cells. Second, a state of liver dysfunction exists and either initiates, accompanies or follows the jaundice. Third, the lack of bile in the intestinal tract is followed by disturbance in the secretory and absorptive functions which normally obtain in its presence.

In this paper it would seem advisable to confine our discussion to that group of patients whose jaundice results from mechanical obstruction of the flow of bile into the intestinal tract. In these cases the ultimate outcome is determined in a large measure by the location, degree and duration of the obstruction, the previous condition of the liver and the functional capacity of the gall-bladder. This concept

is interestingly illustrated in experimental work and clinical practice.

In healthy young dogs one may divide the common duct and suture the ends to prevent the passage of any bile into the intestine. Animals so treated not uncommonly survive the experiment for periods of over a year.<sup>3</sup> Their tissues become deeply stained, but if they are fed properly the dogs remain well much longer than would be expected.

An instructive corollary is found in clinical practice in cases of obstructive jaundice caused by tumors in or about the ampulla of Vater. In these patients a severe obstruction often exists in the presence of a previously undamaged liver and gall-bladder. This obstruction is usually much better tolerated and offers less immediate surgical risk because the liver is relatively free from functional and organic disturbance and the gall-bladder still functions. Although biliary flow is stopped and bile pigment piles up in the blood stream, there is an interval of some duration during which there remains enough of the secretory and metabolic functions of the liver to weather the ordinary surgical storms.

In common duct obstruction by stones, usually associated, as it is, with a shrunken, damaged gall-bladder, the liver also has participated in or has actuated the functional upset and a varying amount of liver deficiency may usually be assumed in these cases. The pathologic physiology which accompanies this type of jaundice has a tendency further to narrow whatever margin of safety exists.

It is unfortunate that no relatively simple test will reveal the true state of the liver or indicate the damage present in

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those organs closely associated in function.<sup>37</sup> Biskind<sup>41</sup> has stated very clearly our present attitude toward liver function tests. He says, "After investigation extending over a period of about forty years, the clinical usefulness of liver function tests has been neither generally accepted nor universally rejected." Ivy<sup>9</sup> is encouraging and takes a definite stand with regard to these tests. He says, "I should never operate on the biliary tract of a jaundiced or non-jaundiced patient without performing beforehand an *bippuric acid test* or *bromsulphthalein* or *galactose liver function test*, and determining the bleeding time and the coagulation time of the blood, except when emergency is definitely indicated."

The problem of pre-operative preparation entails: first, improving or restoring those functions of the liver which have been impaired or lost; and second, aiding, as far as possible, the defense mechanisms which have suffered directly or indirectly from the pathologic crisis exhibited in the biliary tract.

The liver has many and varied functions, but only a few of them are understood well enough to permit designed attempts for their modification or correction.<sup>8</sup> Some of these will be discussed with a view of suggesting methods of management.

#### HEMOCOAGULATION FACTORS

An intensive study has been made of the various blood coagulation factors in jaundice,<sup>7</sup> but no accord has been reached as to the actual cause of the bleeding dyscrasias so frequently encountered.<sup>19</sup> There is no single method of predicting a bleeding tendency which is applicable to all types of hemorrhagic diathesis.<sup>4</sup> In the various types of bleeding it is probable that many factors are responsible, and that different tests are required to demonstrate the bleeding tendency in each.<sup>46</sup> Thus, in purpura the platelet count and in hemophilia the Howell method of coagulation time determination, are the most reliable methods of predicting a bleeding tendency. In jaundice, neither of these nor the

Billi, Bog, or Lee and White method of determining the coagulation time, nor the ordinary Duke method of determining the bleeding time, nor the fibrinogen content, nor the prothrombin content, nor the total calcium nor the sedimentation rate is reliable.

Boyce and McFetridge<sup>21</sup> have outlined a test which they consider reliable in establishing the bleeding tendency in jaundice. The test takes into consideration the firmness, retractility and similar characteristics of the clot, but the principal factor is the ratio of the serum volume to the blood volume. A serum volume index is used as the measure of the bleeding tendency.

The writer has found the Ivy bleeding time test<sup>7</sup> of great value in predicting a hemorrhagic diathesis in the jaundiced patient. This test is performed as follows: A blood pressure cuff is applied to the upper arm, raising the pressure to 40 mm. of mercury and maintaining it for one minute prior to making a 2.5 mm. puncture on the forearm with a mechanical stylet. When the pressure is maintained at 40 mm., the upper limit of bleeding is a normal individual is approximately 240 seconds. In most instances it is less than 180 seconds.

McNealy, Shapiro and Melnick<sup>4</sup> studied 810 cases of jaundice which were admitted to Cook County Hospital during a period of fourteen months. In 64 cases with common duct stone and jaundice, thirty-seven, or 57 per cent, had an abnormally prolonged bleeding time. The Duke bleeding time averaged 125 seconds, but the Ivy bleeding time averaged 330 seconds. In twenty-four surgical patients with carcinoma of the liver or of extrahepatic bile ducts, ten, or 41 per cent, showed a bleeding tendency. Six gave a history of bleeding. The Duke bleeding time averaged 120 seconds, the Ivy bleeding time 430 seconds.

It would seem that a fairly reliable index of the bleeding tendency may be had in the routine use of the Ivy bleeding test. Improvement in the bleeding time as

shown by repeated Ivy bleeding tests is of considerable aid in prognosis.

Methods designed to facilitate and stabilize the clotting of blood, as well as decrease the bleeding time in jaundiced patients must for the present rest almost wholly on empirical practice.<sup>49</sup> A review of literature reveals a great diversity of opinion as to the factors whose variations are related reliably to changes in the bleeding tendency.

Naffziger<sup>13</sup> and his associates have shown that the blood plasma content of sulphur compounds is increased in obstructive jaundice in dogs and in man. They suggest that it is possible that the defect in coagulation is caused by retention in the blood of certain of the organic sulphur compounds which are anticoagulants. They indicate that the metabolism of those sulphur compounds can be decreased by a minimum maintenance diet of protein, by complete rest and by the use of large amounts of carbohydrate in the diet.

There is undoubtedly a disturbed calcium metabolism in jaundice, but its relation to bleeding is not settled.<sup>50</sup> It is suggested that the bile pigments in excess that circulate in jaundice readily form compounds with calcium, so that it is possible they may alter the distribution and "mobility" of this essential element.<sup>27</sup> Blood calcium determinations are of little or no value in determining the bleeding tendency. Ivy<sup>7</sup> states that following the lead of Mayo-Robson,<sup>39</sup> Walters,<sup>49</sup> Whipple,<sup>46</sup> Judd,<sup>30</sup> and others,<sup>12,45</sup> the pre-operative administration of calcium is widely used. Cantarow, Dodek and Gordon<sup>11</sup> have demonstrated an increase in calcium excretion in jaundiced patients. Walters and Bowler<sup>47</sup> have shown that twice the amount of calcium salt must be injected to raise the calcium level to normal in a jaundiced patient as would be required in a normal individual. Rewbridge and Andrews<sup>42</sup> have shown that injecting calcium increases the blood sugar level. Wright and Cowan showed that injection of sugar increases the blood

calcium level. Giving either, therefore, raises the other and it is perhaps impossible to say which is of the greater importance. Hence, the administration of both in adequate amounts seems logically indicated.<sup>43</sup> Borbely has shown experimentally that previous administration of calcium considerably lengthens the time necessary to produce petechiae in the skin by the measured suction method used by Recchia and Signorelli.<sup>10</sup> He concludes that calcium therapy definitely reduces capillary permeability. Minot and Cutler<sup>34</sup> suggest that calcium may act as a physiologic antidote in certain toxic states and Tunnicliff has demonstrated an increased phagocytic power of leucocytes following its use. Regardless of whether the bleeding tendency in jaundice results from calcium defect in the clotting mechanism or depends on an increased permeability of capillaries over which calcium exerts some favorable influence, there seems to be ample evidence that calcium exerts a beneficial influence in jaundice.

#### CALCIUM THERAPY

The proper quantity and the mode of administration of calcium vary considerably according to different writers.<sup>12</sup> Oral administration has been used less frequently in recent years, as the rate of absorption is regarded as too slow for practical purposes. Recent experiments by Ivy would tend to show that the rate of absorption of calcium given orally depends to some considerable degree on the presence of adequate free hydrochloric acid in and the rate of emptying of the stomach. Since many patients with gall-bladder disease may have an achlorhydria the use of peroral calcium might be questioned in these cases. In most instances a more rapid and intense effect is had by the use of soluble salts intravenously. Those most commonly used are 10 per cent solutions of calcium chloride or calcium gluconate. These may be had in ampule form ready for use and are usually given in 10 cc. amounts once or twice daily. The chloride

produces a very marked necrosis of the overlying tissues if any escapes during or after injection. The gluconate is much less irritating and may even be given intragluteally to prolong the action.

#### GLYCOGEN STORAGE

Glycogen storage and mobilization are exceedingly important functions of the liver.<sup>26</sup> While muscle glycogen comprises the largest amount of stored carbohydrate in the body, it is the liver glycogen which is first depleted by fasting. It has been shown repeatedly that livers with a low glycogen content are more susceptible to injury. The ability of the liver to store glycogen is an index of its functional capacity. This organ may store as much as 300 Gm. (10 ounces) of glycogen readily subject to glycogenolysis with formation of glucose. The value of selective diet in jaundice is emphasized by the experimental work of Mann and Bollman<sup>1</sup> who showed that jaundiced dogs failed to survive a diet of meat for more than a brief period, but would live several months on a diet of milk and syrup. A diet high in carbohydrates should be given where the patient can take food. It has been our practice to allow the patient to have a rather liberal diet if no vomiting or colic is present. The liberal use of cereals, gruels, jellies, jams, syrups and fruit juices is encouraged. Green salads and fresh citrus fruits are given with dressings of a very palatable type made with mineral oil. The protein side of the diet should be limited to milk and egg proteins.<sup>23</sup> Where food cannot be taken or urgency exists, it becomes necessary to resort to parenteral glucose administration. The practice of giving glucose solutions per rectum is of doubtful value. In studies made by the writer and others, it was shown that little glucose is absorbed from the colon.<sup>5,6</sup>

It would seem more practical to administer glucose either subcutaneously or intravenously. A 5 per cent solution in distilled water properly buffered may be used for either.<sup>31</sup> The amount and rate

of administration demand some caution. When given intravenously the rate should not exceed 2 drops per second and should preferably be slower. The usual practice is to give about 3000 to 4000 c.c. of a 5 per cent solution in twenty-four hours. The urine is tested frequently the first and second days of use and if no sugar appears in the urine, tests are made daily thereafter. The initiation of glucose therapy *should not be delayed* until the last minute and then pushed so rapidly that untoward reactions appear and much of the sugar spills over in the urine. *It should be started as soon as the patient becomes a surgical prospect* and continued until the convalescence is definitely established and the patient is able to ingest a near maintenance value of easily assimilable carbohydrates.

The use of insulin to facilitate glycogen storage is suggested by Lukens<sup>22</sup> who states that glucose and insulin together produce the maximum storage of glycogen in both normal and diabetic animals. In diabetics or those patients with a low sugar tolerance, the intravenous glucose is covered with insulin. Where diabetes is present, one should guard against excessive doses of calcium because of its tendency to raise blood sugar levels. *Insulin is not used in routine cases.*

#### WATER BALANCE

The importance of maintaining water balance in surgical patients has been stressed by Coller and others.<sup>24,25</sup> In the jaundiced patient it is necessary to maintain this balance and to favor elimination. If adequate amounts of fluids cannot be taken by mouth then plain tap water by proctoclysis will serve adequately in most cases. Where some impairment of renal function exists it is better to use tap water than normal salt solution per rectum. In patients whose twenty-four hour output of urine is less than 1000 c.c., and where no serious kidney lesion can be demonstrated, the intravenous administration of 500 to 1000 c.c. of 10 per cent glucose may

increase the urine output. Faltitschek and Hess<sup>14</sup> point out that cellular impairments of the liver, if they reach a severe degree, cause disturbances in the water balance. They suggest that there is also a renal factor concerned in the disordered water economy of patients with liver disease. Here again there probably is a vicious circle whose interruption may prove a considerable task. *Every jaundice patient should have regular pre-operative urinalyses.* Where the jaundice is severe or has existed for some time or the kidneys show a diminished output in the presence of adequate intake, the functional capacity of the kidneys should be investigated and blood chemistry studies made. Means to combat nitrogenous retention and oliguria are those commonly employed in renal dysfunction without jaundice. Coller<sup>24</sup> has shown that at least 3000 c.c. of fluid must be introduced in each twenty-four hours to maintain a water balance. This may be done orally, subcutaneously, or per rectum as indicated.

#### PROTEIN METABOLISM

The liver is necessary for deamination of amino acids, synthesis of urea and destruction of uric acid. In liver damage, protein metabolism is impaired and excess amounts of protein waste products tend to accumulate. A low protein diet will avoid further embarrassment to an already overtaxed liver. Protein feeding increases the bile-salt production. Since retained bile salts may account for some of the toxemia in jaundice, it would seem important to limit protein intake both before and after operation.<sup>15, 16</sup>

The liver is also the principal site of formation of fibrinogen and exerts a regulatory influence over the albumin-globulin ratio of the blood plasma. The fairly constant disturbance of the albumin-globulin ratio in liver damage suggests the use of this finding as a prognostic aid. When present this should serve as a warning against surgery except under the most unusual circumstances.<sup>18</sup>

The work of Whipple indicates that the liver is intimately associated with the production of hemoglobin. Snell<sup>36</sup> suggests that a patient who has a chronic hepatic lesion is poorly equipped to adjust himself to even the less severe degrees of anoxemia because of the limitation in production of hemoglobin.

#### BLOOD TRANSFUSIONS

In the presence of jaundice with its associated hepatic damage, blood transfusions have a favorable influence. More hemoglobin is supplied, thus increasing the oxygen capacity of the blood. There is a better saturation of the arterial blood with oxygen which occurs either as a result of an improvement in the general circulation or in some change in the character of the blood. There also occurs an increase in the functional capacity of hemoglobin. In discussing the value of blood transfusions in jaundiced patients, Judd<sup>29</sup> refers to the work of Rich who noted atrophy of cells around the central veins of the hepatic lobules, presumably the result of an oxygen deficiency. Anoxemia results in liver damage and the damaged liver in turn perpetuates the anoxemia by its limited production of oxygen carrying hemoglobin. This vicious circle should be interrupted by early blood transfusions. In most cases one or two, or in desperate risks, even more transfusions of 500 c.c. of blood should precede surgery.

#### VITAMIN SYNTHESIS

The liver plays an important rôle in vitamin synthesis and storage. In the jaundiced patient the liver may be damaged so that absorption, synthesis and storage of vitamins may be deficient. If adequate bile does not reach the intestinal tract there occurs a marked disturbance of fat digestion and absorption. Ingested fat appears in large quantities in the feces of animals whose bile is diverted from the intestinal tract. It is reasonable, therefore, to expect those vitamins which are fat soluble to be excreted along with the

undigested fat. The best known fat soluble vitamins are A and D.

**Vitamin A.** Vitamin A acts by increasing the ability of the body to resist disease.<sup>33</sup> It is suggested that it has to do with the maintenance of intact, healthy epithelial membranes which constitute the first line of defense against bacterial invasion. The principal source of vitamin A is in fats of animal origin. Schmidt and his co-workers presented evidence that absorption of vitamin A, in the form of cod liver oil, occurs in the absence of bile in the intestine, but beta carotene, the precursor of vitamin A, is not absorbed in the absence of bile. Since cod liver oil is not an item in the average diet, it is likely that the vitamin A intake is almost wholly ingested in the form of carotene.

As a precautionary measure against deficiency it would appear that Vitamin A in concentrated form should be administered as a routine part of the pre-operative preparation in those patients who give a history of long standing gastrointestinal disturbances and especially in those who show a low blood platelet count. In severe obstructive jaundice it may be given parenterally or if given orally it should be administered along with bile salts. It has been our practice to use commercial ox or pig bile in 5 to 7 grain doses three times a day. Our use of commercial ox or pig bile seems warranted because Horrall,<sup>15</sup> Still and their associates have analyzed a number of these products and find them to contain sufficient bile acids and salts to act on the fats in the alimentary canal and enhance the action of lipase. The use of dehydrocholic (triketocholelonic) acid (decholin) is contraindicated in obstructive jaundice and it should not be used as a substitute for the whole bile mentioned above. Dehydrocholic (triketocholelonic) acid (decholin) acts as a choleric, increasing the flow of bile. Its use *after the release of the obstruction* in jaundice has been a routine procedure in our cases. In some instances the twenty-four-hour output of bile has been augmented by 50 per

cent following its administration. It remains to be established by further investigation whether this is a valuable procedure.

**Vitamin D.** The functions of vitamin D are to facilitate the absorption of calcium and phosphorus from the intestine and maintain the level of calcium and phosphorus in the blood.<sup>32</sup> It increases the net retention of calcium in the body in ordinary doses. Like vitamin A, its absorption rate from the intestine bears a distinct relation to the fat absorption rate, which in turn is dependent on the presence of bile in the intestinal tract. This fact was established by Greaves and Schmidt<sup>38</sup> in 1932 and confirmed by Taylor in 1935. The importance of an adequate vitamin D absorption has been established in clinical practice by the work of McNealy, Shapiro and Melnick<sup>4</sup> and further substantiated by the recent work of Johnson<sup>51</sup> and by Boys<sup>53</sup> of Ann Arbor. The method of administration commonly employed is to give 30 drops of viosterol, 250 D, three times a day. Viosterol is usually administered in conjunction with the carotene and commercial ox or pig bile as was described under vitamin A therapy.

**Vitamin C.** Vitamin C is the water soluble anti-scorbutic element which occurs in fresh foodstuffs, fruit juices, and vegetables, and is found in small amounts in fresh milk and raw meat juice. The absence of vitamin C from the diet produces a condition known as scurvy, whose characteristic symptom is hemorrhage. The hemorrhages may be due to changes in the vessel walls. It is possible that vitamin C controls the nutrition of the endothelium of the capillaries.<sup>31</sup> At the present time estimations are being made of the cevitamic acid concentration in the blood of all patients suffering from gall-bladder disease who are admitted to our service at Wesley Memorial Hospital.

One of my associates, Dr. Gubler, has been making a study of the deficiency states which result from restricted dietary régimes commonly exhibited in patients with gall-bladder dysfunction. Several instances of subclinical scurvy have been

noted. It is possible that this may be an important hemorrhagic factor in some jaundice cases. It is, at least, an indication for regular estimation of vitamin c in chronic cases and if a deficiency state is found, it should be corrected. Orange juice sweetened with glucose will be efficient if the patient can take food by mouth. If parenteral administration is necessary it may be given subcutaneously in daily .025 to .050 mg. doses of cevitamic acid until a normal blood level is reached.

#### SUMMARY

The preparation of the jaundiced patient includes all of the precautionary and rehabilitative measures which should precede every major operation.

In addition it should include measures directed toward a reduction of the hemocoagulation time and the bleeding time.

The diet should be rich in carbohydrates and poor in proteins.

The water balance should be regulated.

In chronic cases blood chemistry studies should be made where there is indication of disturbance of renal function.

Glucose should be administered in adequate amounts. An isotonic, properly buffered solution in distilled water may be used intravenously or subcutaneously.

Normal salt solution should be given in sufficient amounts to overcome the loss of salts by vomiting or diarrhoea.

Blood transfusions are of definite value.

The use of calcium salts intravenously is indicated.

Vitamin deficiencies should be corrected by the administration of the fat soluble vitamins A and D and the water soluble vitamin c.

Orally administered bile preparations are used to facilitate the absorption of the fat soluble vitamins.

#### CONCLUSIONS

The proper pre-operative care of the jaundiced patient will reduce the mortality in these cases.

In no case should the surgeon assume the burden of operating upon these patients without first assuring himself that every effort has been made to protect the patient from hazards signalized by the symptom complex of jaundice.

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# ACUTE PANCREATITIS\*

WITH SPECIAL REFERENCE TO PATHOGENESIS AND THE DIAGNOSTIC VALUE  
OF THE BLOOD AMYLASE TEST

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AN enormous amount of confusion exists in the classification of acute pancreatitis. The most simple classification would be a division of cases into acute edematous or acute interstitial (Elman<sup>1</sup>) pancreatitis and hemorrhagic (necrotic) pancreatitis. Since there is considerable variation in the cases falling in the latter group, McWhorter<sup>2</sup> has very aptly subdivided this second group into hemorrhagic, necrotic and suppurative.

The greatest clinical difference is noted between the acute edematous or interstitial type and the remaining three groups. In the first place the acute interstitial type is far more common than even the total of the remaining three groups, as may be noted by the fact that six of a small series of eight cases of proved acute pancreatitis observed here at the Illinois Research and Educational Hospital in eighteen months, belonged to this group. In addition, this type presents much less fulminating symptoms and a mortality rate of 5 to 10 per cent in contrast to 50 to 55 per cent encountered in the hemorrhagic necrotic group. These four groups are not to be confused with a still more common but chronic type of pancreatitis consisting of induration of the head of the pancreas, and encountered so frequently in patients with chronic cholecystitis and other inflammatory lesions within the abdomen.

There is no agreement as to the pathogenesis of acute pancreatitis, but one of the most significant and prominent features is its association with gall-bladder disease. It is possible, as has been suggested by many observers, that the pathogenesis is the

same in all four groups, but that they represent different stages in the same disease—the acute edematous type obviously representing the early stage.

*Pathogenesis.* Much disagreement exists as to the pathogenesis of acute pancreatitis. Many possible theories have been offered, including reflux of bile into the pancreatic duct, activation of trypsin within the pancreas, infection, etc. Part of the confusion is probably due to the fact that the factors may be multiple and are not identical in all cases.

The theory of reflux of bile had its origin from the experiments of Claude Bernard in 1856, who showed that the injection of bile and sweet oil into the pancreatic duct would produce acute pancreatitis. Archibald,<sup>3</sup> who was a strong advocate of the reflux theory, thought that abnormal bile, spasm of the sphincter of Oddi and increased pressure within the biliary tract produced by the gall-bladder and other mechanical factors, were important points. It is a well known fact that certain constituents of bile, most likely the bile salts, are injurious to tissue cells and it is assumed by many that this in a way explained the toxic effect upon the pancreas.

However, it is equally well known, as first demonstrated by Opie,<sup>4</sup> that the injection of bile into the pancreatic duct rarely would produce an acute pancreatitis unless it was injected under pressure. Mann and Giordano<sup>5</sup> showed that the injection had to be made with a pressure of at least 1000 cm. of water before acute pancreatitis would be produced. This then brings up the added factor of trauma as an important

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one in the production of acute pancreatitis, particularly when we consider that any number of substances will produce the disease if injected under sufficient pressure.

The clinical observation that acute pancreatitis usually develops two or three hours after a full meal has undoubted significance, particularly since a relationship has likewise been noted experimentally. For example, Eggers<sup>6</sup> has noted that the procedure of ligation of the pancreatic duct in animals would produce acute pancreatitis only when performed during active digestion. It is difficult to determine why this should be true unless we consider that an increase in intraductal pressure is produced, perhaps with rupture into the parenchyma, and that the secretion (particularly trypsin) is produced in a more active form at that time. Moreover, Brocq and Morel<sup>7</sup> noted that in order to produce pancreatitis experimentally with a small amount of normal bile, it had to be injected about three hours after a heavy meal.

The relationship between cholelithiasis and acute pancreatitis has been appreciated for years. Jones<sup>8</sup> found gallstones in 49 per cent of a series of forty-three patients with acute pancreatitis. Dragstedt and associates<sup>9</sup> have estimated that acute pancreatitis is associated with gall-bladder disease in 60 per cent of cases. In the small series of eight cases described in this report, all had badly diseased gall-bladders, seven of which contained stones, and five had stones in the common duct. In a series of six cases of acute pancreatitis reported by Eggers,<sup>6</sup> five had stones in the gall-bladder and the other had a badly diseased gall-bladder. The fact that cholecystitis and cholelithiasis are important in the pathogenesis of acute pancreatitis can, then, scarcely be denied. The importance of the presence of gall-bladder disease in the pathogenesis of acute pancreatitis is brought to our minds more forcibly when we recall that very seldom indeed do we encounter acute pancreatitis after the gall-bladder has been removed except when the pancreatitis is a continuation or residue

of an infection existent at the time of cholecystectomy.

Opie<sup>1</sup> (1901) was perhaps the first to present evidence that obstruction of the common duct at the sphincter of Oddi was associated with the development of acute pancreatitis. It was Opie's contention that the obstruction produced by the stone allowed the development of a common channel, with the reflux of bile into the pancreatic duct. The plausibility of this theory rests largely upon the frequency of a junction of the common bile duct and duct of Wirsung, at least 0.5 cm. proximal to the opening in the duodenum. The importance of this theory is emphasized when we consider the fact that the injection or entrance of bile into the pancreatic duct is perhaps the most efficient method of producing acute pancreatitis experimentally. Although many chemical substances, including gastric juice, alkalis, calcium chloride, etc., will produce acute pancreatitis when injected into the duct, bile will produce it more readily than practically any other substance.

In an anatomic study of human pancreases, Opie concluded that in 90 per cent of cases the common bile duct united with the duct of Wirsung before emptying into the duodenum, but Mann and Giordano<sup>5</sup> concluded that in only 3.5 per cent of cadavers did the junction occur far enough away from the duodenum so that the production of a common channel by the impaction of a stone at the sphincter of Oddi was possible. However, the work of Cameron and Noble<sup>10</sup> seems to prove conclusively that such a junction exists in a very large percentage of human cadavers. They introduced a small biliary calculus into the ampulla of Vater, and by forcing fluid into the hepatic duct at a pressure of 100 mm. of water, noted that a reflux of bile into the pancreatic duct occurred in sixty-six of one hundred fresh human cadavers.

The importance of the reflux theory is borne out still further by the experiments of Wangensteen and associates.<sup>11</sup> They

noted that if the sphincter of Oddi was mechanically blocked in cats by a suture, gross evidence of reflux of bile into the pancreatic duct with the production of acute pancreatic necrosis was noted in fifteen of thirty-one instances, after a stimulus furnished by a fat meal; the contractile mechanism of the gall-bladder was obviously the factor producing the reflux of bile into the pancreatic duct.

The clinical inference to be drawn from these experiments would lie in the possibility that spasm of the sphincter of Oddi might act as an obstruction, as suggested many years ago by Archibald.<sup>3</sup> There appears to be no doubt that the human being is far more susceptible to disturbances in visceral nerve supply which lead to the production of spasm (e.g., pylorus, cardiac portion of stomach, etc.), than are most animals. During the last year or two, evidence is accumulating to support the contention that a spasm of the sphincter of Oddi does actually occasionally exist in the human being. However, in view of the evidence recently offered by Boyden<sup>12</sup> that the major portion of muscle fibers in the sphincter of Oddi are located in the ampullar region above the junction of the pancreatic and common bile duct (sphincter choledochus), it is doubtful if spasm of this sphincter would be instrumental in producing a common channel for the reflux of bile into the pancreatic duct.

The supposition that bile may be forced into the pancreatic ducts, when anatomic structures permit, is met with opposition by the experiments of Wolfer,<sup>13</sup> who noted that the secretory pressure of the pancreas was actually greater than the secretory pressure of the liver. This relationship of the secretory pressure of the two organs has been confirmed by Rich and Duff,<sup>14</sup> and Dragstedt and associates.<sup>9</sup> In view of the fact that the secretory pressure of the pancreas is probably greater than that of the liver, some workers contend that the presence of an intraglandular anastomosis between the ducts of Wirsung and Santorini, as demonstrated by Opie in about

nine-tenths of individuals, might permit the flow of bile into the pancreas with subsequent toxic action when an obstruction was present at the sphincter of Oddi. A recent clinical report by Robins<sup>15</sup> would appear to prove that reflux from the common bile duct into the pancreatic duct can occur. The patient reported by him had small stones (identical with those found in the common and hepatic bile ducts) in the pancreatic duct.

Through some experiments performed many years ago, Flexner<sup>16</sup> concluded that infection played but a small rôle in the pathogenesis of the disease. In a series of eighty cases in which cultures were taken, Truhart<sup>17</sup> found negative cultures in forty-three, *Bacillus coli* in twenty-two, micrococci in ten instances and unidentified organisms in five. More recent reports do not reveal so large a percentage of positive cultures. In fact, there are numerous reports including a small number of cases in each group, in which all cultures are negative. It is agreed that infection is of course an important factor in suppurative pancreatitis, but perhaps in a secondary way. It is doubtful if acute pancreatitis is ever produced by spread of infection by way of lymphatics from other organs. Invasion of the head of the pancreas by infection from the common duct might be an etiologic factor in an occasional instance.

In animal experiments Dragstedt<sup>9</sup> noted that the presence of infection along with the chemical action of the bile and pancreatic enzymes was a very important factor in the development of the toxicity accompanying the pancreatitis, although he likewise found enough evidence of trypsin digestion to allow the assumption that trypsin was an important factor in the causation of the pathologic picture. Undoubtedly infection likewise plays a similar rôle in acute pancreatitis in human beings, but as Dragstedt suggested, only in a small percentage of cases.

Rich<sup>14</sup> has been able to obtain sufficient digestive action and vascular lesions following the subcutaneous injection of inac-

tivated trypsin to lead him to conclude that the old theory of activation of trypsin and its digestive action is important in the pathogenesis of acute pancreatic necrosis. The problem of determining how this trypsin, as liberated through intraglandular injury of the pancreas, could be activated, has been a stumbling block in acceptance of this theory. Rich concludes that either the trypsin can be secreted by the pancreas in an activated form, or it becomes activated by the calcium in the tissue fluids. Since he was able to demonstrate the presence of bile in the pancreatic ducts in such a small number of cases of acute pancreatitis, Rich was led to believe that the acute pancreatitis was produced by the rupture of intraglandular ducts with the escape of pancreatic secretion into the parenchyma of the gland and by subsequent digestive action with erosion of blood vessels. He contends that metaplasia of duct epithelium in the pancreas is a frequent occurrence and because of the obstruction produced, accounts for dilatation with consequent rupture and escape of secretions.

The toxic effect of the disease upon the patient is assumed to be produced by the action of the split protein liberated by the tryptic digestion. The toxicity is enhanced greatly by the implantation of bacteria, because of the increase in destruction of the gland and the bacterial toxins (Dragstedt). The diffuse hemorrhage which may be noted throughout the gland was found to be produced by the digestive action of trypsin on the arterioles (Hildebrandt<sup>18</sup>). Fat necrosis is produced by the action of steapsin (one of the lipases) on fat with the production of fatty acids and glycerine.

In summarizing the pathogenesis of acute pancreatitis, it would appear that the acute edematous (interstitial) type is produced by an obstruction of the pancreatic ducts. This produces swelling of the glands with very little pathologic change except edema and with slight cellular infiltration, as has repeatedly been shown by biopsy.

The obstruction may be produced in the body of the gland by metaplasia of intraductal cells (Rich), by compression of the main duct by stone, or by compression because of invasion of infection from the common duct. The rather rapid clinical recovery of the patient and the subsidence of the elevated blood amylase within a few days may possibly be explained on the assumption that the pancreatic secretions have established exit through the anastomotic channels demonstrated by Opie. If bile is forced up into the pancreatic duct by reflux, as apparently happens only occasionally, the irritating effect of the bile salts would undoubtedly aid in the rupture of small ducts with escape of pancreatic ferments into the parenchyma of the gland. This rupture of tiny ducts might be brought about by obstruction alone (Rich). At any rate it is assumed that digestive action cannot take place without trauma of some type. This assumption is supported by the fact that a normal pancreas, transplanted into the duodenum without trauma or loss of blood supply, will not be digested by the activated enzymes (Rosenbach). Necrosis and hemorrhage are quite certainly the result of tryptic digestion except that focal areas of necrosis might be produced by local areas of ischemia resulting from compression incident to the edema. Suppuration is obviously secondary to bacterial invasion, which probably is very rarely a primary process.

*Clinical Manifestations.* The manifestations of acute hemorrhagic or necrotic pancreatitis are quite dramatic. The symptoms usually develop rapidly, frequently, two or three hours after a full meal, and usually in patients who have previously been in good health, although in McWhorter's<sup>2</sup> series there was an antecedent history of previous attacks in 37 per cent. Symptoms consist primarily of pain in the epigastrium, nausea and vomiting. Soon after the onset the pulse becomes rapid, and within two or three hours after onset the patient may actually be in a stage of moderately severe collapse and shock, with

tachycardia, thready pulse, low blood pressure and even cyanosis, as described in cases reported by Gatewood,<sup>19</sup> Eggers,<sup>6</sup> Jones,<sup>8</sup> and others. However, Wangenstein<sup>11</sup> has called attention to the fact that shock is in reality an *uncommon* manifestation. The pain is usually located in the epigastrium, extending to the left upper quadrant and may radiate posteriorly to the dorsal spine. Fever is rarely present, particularly during the first several hours of the disease; in fact a subnormal temperature is usually encountered at the onset when the evidence of circulatory collapse is so pronounced. After the first day or two a mild fever of 100 to 101°F. is commonly present. Nausea and usually vomiting are present; vomiting is frequently a very prominent feature of the disease, so much so in fact, that it may be of important diagnostic significance. The abdomen is usually tender throughout, but most acutely in the epigastrium and left upper quadrant. Muscle spasm is variable, but frequently is slight or even absent.

The clinical picture is obviously one resembling a toxemia and not that of an infection. Leucocytosis usually varies between 15,000 and 25,000, but is not always present. In fulminating cases, the signs of collapse may proceed unless active measures are taken to combat the shock, and death may take place twenty-four to forty-eight hours after onset. In the suppurative type, fever of 101 to 104°F. usually develops within a day or two after the onset and along with a significant leucocytosis. The presence of fever of this type is of considerable importance as will be discussed under treatment, since it may be the most reliable evidence available that an abscess is forming and may therefore be a strong indication for laparotomy.

Occasionally a mass will be palpated in the region of the pancreas. At operation the pancreas is practically always found enlarged two or three times. If the surgeon palpates the pancreas there will never be any doubt about the involvement of the organ, which is likewise indurated and

commonly nodular. It may be diffusely hemorrhagic; less commonly, only local hemorrhagic areas will be noted. A small amount of sanguinous fluid is usually found in the peritoneal cavity. There may be no hemorrhage into the pancreas, but instead, local areas of necrosis will be found. Areas of fat necrosis are usually found in the peritoneum and omentum.

The manifestations of *acute edematous or interstitial pancreatitis* are very similar to those described above, except that they are of less intensity. Shock is never encountered in this type of the disease. Fever may or may not be present. The patient presents a tired, worn expression, indicative of toxemia. Nausea and vomiting are usually present, particularly at the onset. The amount of tachycardia varies with the degree of toxemia. Mild or latent jaundice is present in about a third of all types of pancreatitis, but deep jaundice is not present unless the common duct is blocked by a stone, a condition which does not often accompany acute pancreatitis. Pain is not quite so severe as in hemorrhagic pancreatitis. In the cases described in this report the pain was perhaps most severe in the epigastrium and distributed about equally over the right upper and left upper quadrants. The gall-bladder disease which is so frequently present in either type of pancreatitis may be sufficiently acute as to mask the manifestations of pancreatitis considerably; on such occasions the pain and tenderness over the right upper quadrant may be more acute than elsewhere over the abdomen. In contrast to acute hemorrhagic, necrotic and suppurative pancreatitis, there is a tendency for the pain and other manifestations to subside within two or three days, particularly if bed rest, administration of fluids, etc., are maintained.

In this type of acute pancreatitis, there will likewise rarely be any question about the presence of the lesion if the pancreas is palpated. The induration and swelling will be just as prominent as in the hemorrhagic type, but free fluid is rarely present.

Fat necrosis will rarely be absent, and apparently persists for at least two or three weeks following the onset of the acute attack.

necrosis will be elevated, but in a bleeding ulcer will show an appreciable fall within a few hours after the hemorrhage. Differentiation between acute interstitial pan-

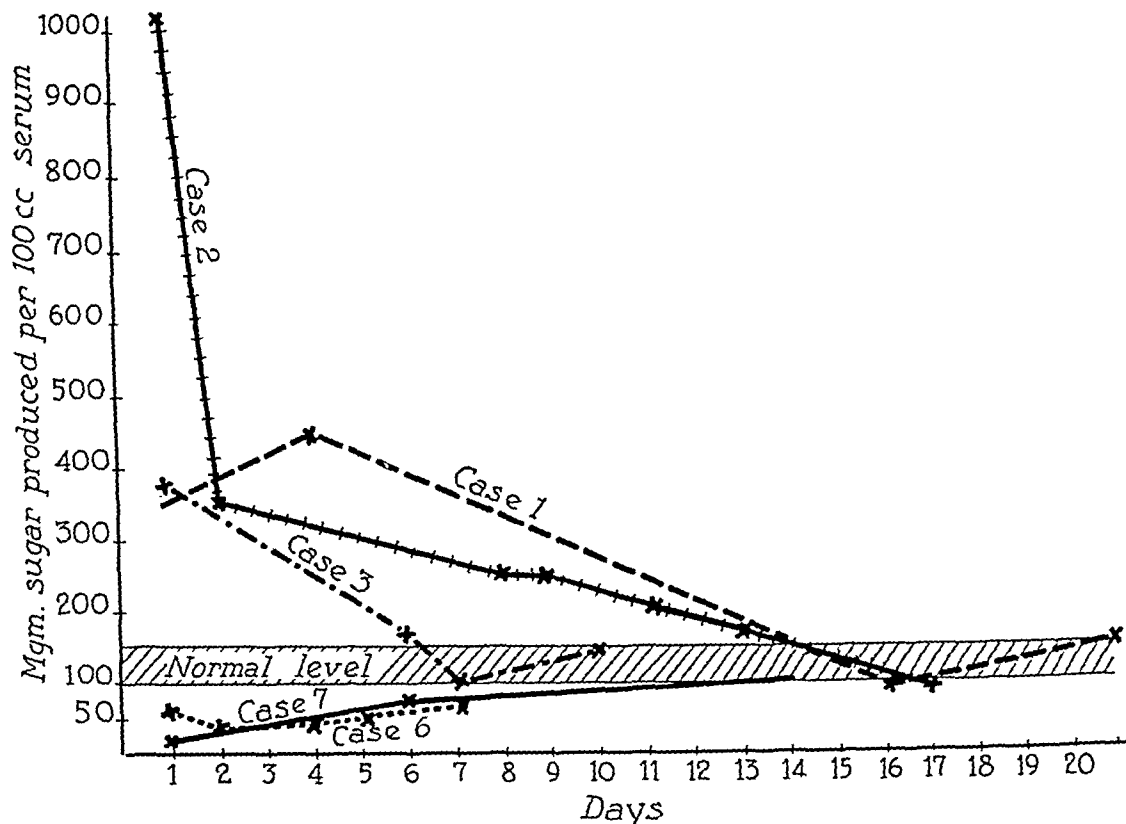


FIG. 1. The above graphs illustrate the level of blood amylase in five of the eight cases reported here. From the protocol and chart showing summaries of the cases, it will be noted that the interval since onset of symptoms is not greatly different in the group with elevated amylase and those with low blood amylase. This is a bit unusual insofar as most observers have noted that the elevation of blood amylase was not encountered so long after onset. Of the three remaining cases, one is depicted in Figure 2; the second had only one reading (54); the third had a persistent elevation for two weeks preceding operation, and several weeks after operation. Persistence of an elevated amylase for such a long period is very unusual.

**Diagnosis.** Errors in diagnosis are extremely common in all types of pancreatitis. The pain in the epigastrium, and manifestations of collapse in hemorrhagic, necrotic or suppurative pancreatitis may lead one to the erroneous diagnosis of perforated ulcer, but the tachycardia which is usually present in the former instance is uncommon in a recently perforated ulcer. These types of pancreatitis may likewise be confused with a severe intra-abdominal hemorrhage, as from a duodenal ulcer, but if hemorrhage is very severe from either a gastric or duodenal ulcer the vomitus will almost always contain blood. Furthermore, the erythrocyte count in acute pancreatic

creatitis and acute cholecystitis may be extremely difficult, particularly because a certain degree of gall-bladder disease may be present with the pancreatitis. One of the most valuable points in differentiation will be the presence or absence of tenderness in the epigastrium and particularly in the left upper quadrant. Rarely does significant pancreatitis exist without a demonstrable tenderness extending to the left across the upper abdomen.

One of the most amazing features of acute pancreatitis, when we consider the gross pathologic appearance of the pancreas, is the relative infrequency of glycosuria. In de Takats' and Mackenzie's<sup>20</sup>

series, glycosuria was noted in only four of thirty cases. In a group of cases consisting of acute edematous pancreatitis alone, it would probably be still less frequent. However, an elevated fasting blood sugar is a rather consistent finding, particularly in the hemorrhagic and necrotic types. Krotoske<sup>21</sup> has called attention to the fact that an elevated blood sugar is fairly constantly observed in acute pancreatitis. Amylase determination may be of more specific value, however. The author agrees with the opinion of many others who have recently made a study of the value of amylase determination, that this procedure is one of the most valuable diagnostic procedures available.

*Value of Blood Amylase Test.* The diagnosis of acute pancreatitis is so difficult that every available diagnostic aid must be utilized as much as possible. An analysis of the numerous reports in the literature dealing with amylase and lipase tests suggests that considerable diagnostic aid can be derived from this source. Since I have had no personal experience with the lipase test, all my remarks on laboratory procedures will be limited to the blood amylase test, which has been popularized recently by Elman<sup>1,22</sup> and associates.

It has been known for years that amylase is secreted by the pancreas, salivary glands, liver, and to a slight extent, by the duodenal glands. The fact that ligation of the pancreatic duct always results in a sharp and pronounced rise in blood amylase,<sup>23,24,25,26,27</sup> which reaches its maximum in a day or two, and gradually falls to normal in ten to fourteen days, is very suggestive proof that in the human being, a lesion which would result in acute mechanical obstruction to the ducts, regardless of whether it was of inflammatory or purely mechanical origin, would likewise result in a rise in blood amylase. However, the fact that pancreatectomy is not followed by an appreciable fall in the amylase level<sup>27,28</sup> during the first day or two, would lead one to believe that the normal level of blood amylase is maintained for the

most part by organs other than the pancreas. Somogyi<sup>29</sup> is of the opinion that the liver is the chief organ responsible for the maintenance of the normal level of blood amylase.

Attempt has been made (Wolfer and Christian<sup>30</sup>) to utilize the excretion of amylase in the feces as an index of pancreatic activity, but too much individual variation was found to offer hopes of utilizing the test clinically.

Ligation of the common bile duct is followed by a rise in blood amylase although it may be no more than two or three times the normal value (Wohlgemuth,<sup>26</sup> Crandall and Cherry<sup>31</sup>). This fact corroborates to a certain extent the assumption that the liver is an important source of blood amylase. Injection of bile salts and other substances into the pancreatic duct (which has been shown to produce acute pancreatitis as noted previously) is likewise accompanied by a rise in blood amylase (Clasen<sup>32</sup> and McCaughan and associates<sup>33</sup>). If bacteria are injected along with the bile salts the rise in blood amylase is still greater.

Analysis of the various clinical reports of observers<sup>20,32,34,35,36</sup> who have recently made a study of amylase determination and our own clinical experiences will reveal an increase in blood amylase only in acute pancreatitis. This is about as reliable in the acute interstitial pancreatitis as in the more fulminating forms except that a normal or low reading may be encountered more frequently in the latter group. The level rises from its normal\* of 90 to 150 within a few hours, and in a day or two may be as high as 1000. It falls gradually until the normal threshold is reached, usually within two or three days after onset of symptoms. It has been noted repeatedly that the level of blood amylase may return to normal many days before

\* Readings are expressed in terms of milligrams of sugar produced by the amylolytic action of 100 c.c. of serum on a given amount of starch. In the series herein reported the Somogyi modification of the Wohlgemuth test was used. See reference 29.



the symptoms subside, although on numerous occasions there will be a direct correlation between the return of blood amylase to normal and the subsidence of symptoms.

depressed, presumably because at the time the blood was collected the parenchyma of the pancreas was so totally destroyed that no secretion of enzyme was taking place.

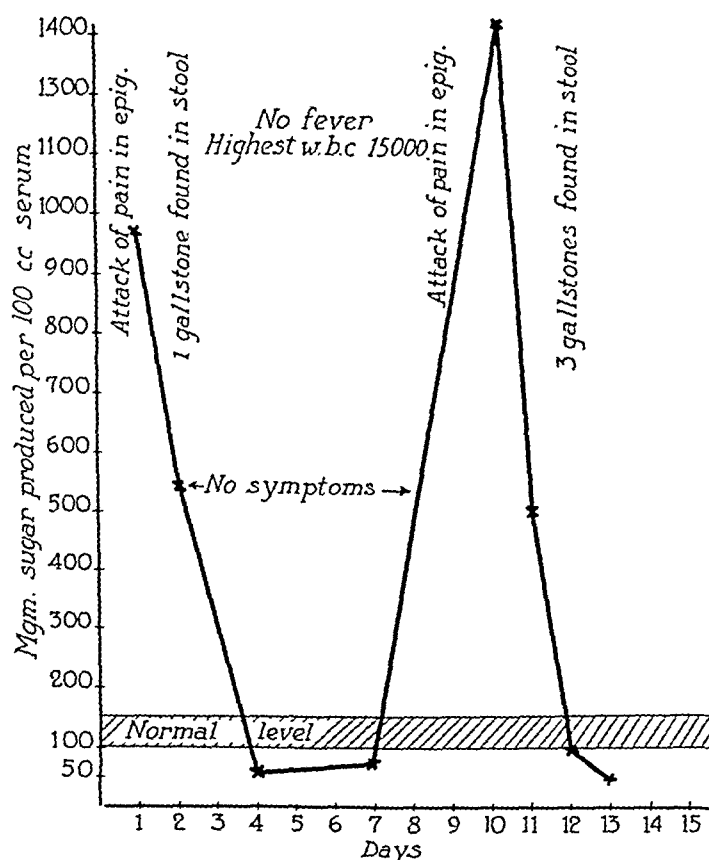


FIG. 2. The elevation of blood amylase with subsequent rapid fall, as shown above during two attacks of epigastric pain, represents a more typical response than some of the curves shown in Figure 1. The fact that gallstones were found in the stool following each of the two attacks suggests very strongly that the passage of the stones was an important factor in the production of the pancreatitis, which was of the edematous type, as demonstrated later at operation. Whether or not the stone produced a one-way channel allowing reflux of bile into the pancreatic duct, or whether the stone caused obstruction of the pancreatic duct by compression as it was being passed, cannot be determined. The fact that no evidence of bile in the pancreas was noted at operation might indicate that the latter mechanism was the more probable.

On rare occasions an increase in blood amylase will be found to exist over a period of greater duration, but usually only as secondary exacerbations, as was noted in one of the cases in the series herein reported. (Fig. 2.) As previously stated, in the fulminating type of acute pancreatic necrosis, the blood amylase occasionally may not be elevated, but may even be

Apparently, observations on the urinary diastase<sup>35</sup> have about as much diagnostic value as the blood amylase. Gray and Somogyi<sup>36</sup> have shown that although there is more amylase in the urine than in the blood, there is a greater individual variation in the same patient. The ratio of urinary to blood amylase may vary all the way from 2 to 1 to 6 to 1. The urine amylase

remains elevated twenty-four hours longer than the blood amylase and is lowered by renal disease.

In over 50 per cent of instances of pancreatic cyst the test will be positive. In carcinoma of the pancreas the test will reveal an increase in blood amylase in only a small percentage of cases; in chronic pancreatitis the test is practically always negative. A negative test may then be of little value diagnostically, but in none of the various reports reviewed in the literature did the author encounter an elevated reading except when serious pancreatic disease was present.

Considerably more difficulty is encountered in interpreting low blood amylase readings. Early reports by various workers concluded that they were explained by a fibrosis and atrophy of the gland, but more recent work (Somogyi<sup>29</sup>) suggests that on many occasions at least, the low readings are indicative of hepatic disease. This assumption is supported by a patient recently observed by the author. The blood amylase readings in this patient were consistently low over a period of three or four weeks' observation. At operation, the pancreas appeared normal, but a huge mass in the upper abdomen proved to be a liver riddled and practically destroyed by innumerable cysts measuring from 0.5 to 25 cm. in diameter.

On the other hand, it is very common to observe the recession of an elevated blood amylase extend far below normal in patients having acute pancreatitis, as proved by operation, and with a liver presenting very little, if any, evidence of disease. It appears that the low readings might be explained on the basis of two possibilities. In one group an hepatic disease might be the most important factor. In the other group it appears logical to assume that when the amylase is elevated considerably above normal by the pancreatic disease, secretion of amylase by the liver, as well as by the pancreas, is held down to a minimum and returns to normal slowly (clinically eight to twenty days) after the

pancreatic obstruction is released. Many similar physiologic responses can be related. A very dramatic example is the control of the amount of secretion of insulin by such simple procedures as alterations in diet.

*Treatment.* Treatment of interstitial pancreatitis should be conservative during the acute stage. It will usually be necessary to administer subcutaneous saline and intravenous glucose, particularly if the patient is vomiting. Since the majority of patients with acute pancreatitis also have gall-bladder disease, they should be observed with this possibility in mind during convalescence, and x-ray studies made. Any operative procedures are therefore directed toward relief of the gall-bladder disease. Obviously, operations on this organ will be tolerated better if postponed until the acute symptoms have subsided and the blood amylase has returned to normal. In the small series of patients herein reported, all but two of which were acute, but of interstitial type, that policy was adopted (except Case v), and there were no fatalities in this group.

Cholecystectomy with removal of stones in the common duct (if present), is usually the treatment indicated. Many surgeons are reluctant to remove the gall-bladder in the presence of pancreatitis, on the basis that the pancreatitis may produce an obstruction of the common duct and the gall-bladder be needed later for an anastomosis with the stomach or duodenum. The author, however, is inclined to agree with the opinion expressed by Jones<sup>8</sup> when he remarked that in about 2500 cases of cholelithiasis and cholecystitis he had never been obliged to do a cholecystgastrotomy for chronic pancreatitis in the absence of carcinoma.

Considerable disagreement exists as to whether acute hemorrhagic or necrotic pancreatitis should be treated by operation or be treated conservatively at first, and followed by operation on the biliary tract later, as indicated. Advocates of radical therapy advise laparotomy as soon as the

shock (if present) is treated. Operative procedures consist of splitting the capsule of the pancreas with insertion of a drain down to this organ, cholecystostomy and choledochostomy as indicated. It is agreed that cholecystectomy should very rarely be performed at this time. Advocates of conservative therapy contend that drainage of the pancreas is not possible by splitting the capsule, and that more lives will be saved if operation is deferred and performed as indicated (on the biliary tract) at a later date after acute manifestations have subsided.

Obviously, if differentiation between acute pancreatitis and other emergencies, such as perforation of a peptic ulcer, is impossible, an emergency operation will probably be indicated. If suppurative pancreatitis is present, as will be indicated by the persistence of fever and increase in the abdominal signs, emergency operation for drainage of the abscess will likewise be indicated. The author is inclined to favor conservative therapy in all types of acute pancreatitis except the suppurative type and in those cases when differentiation cannot be made from such emergency lesions as perforated peptic ulcer. A more detailed discussion of treatment may be found elsewhere.<sup>2,20,27,28</sup>

#### PROTOCOLS OF CASES

**CASE I.** T. C., a female of 40, three years before entrance had had an operation for severe pain in the right upper quadrant which was noted one hour after eating. Fat necrosis was noted at operation which was performed several days after onset. Cholecystostomy was performed, and the patient was relieved for two years following operation.

Three weeks before her present admission she developed pain in the right and left side of the upper abdomen with nausea and persistent vomiting. Slight icterus was noted for a few days shortly after admission, as were also mild fever and an occasional chill. The maximum leucocyte count was 25,000. The maximum blood amylase was 430. It had dropped to normal (160), as had also the temperature several days before operation was performed.

At operation stones were found in the gall-bladder and common duct. The pancreas was moderately enlarged and nodular, particularly at the head. Areas of fat necrosis were seen. The gall-bladder was removed and the common duct opened. Two stones were removed from it and a T-tube put in. Post-operative course was uneventful.

**CASE II.** B. S., a female of 38, was admitted to the hospital about three years previously with a history of severe colicky pain in the epigastrium and right upper quadrant of five days' duration; radiation of pain posteriorly was likewise complained of. There was a history of dyspepsia, belching, etc., of four years' duration. During the acute attack of pain; nausea and vomiting were present, and there was muscle spasm over the entire upper abdomen. Pain persisted and operation was performed one week after entry. Stones were found in the gall-bladder. Numerous areas of fat necrosis were noted about the omentum. Because of the critical condition of the patient, the stones were removed from the gall-bladder, but only a cholecystostomy was performed.

The patient remained reasonably well until five days before her present admission, at which time she was seized with pain in the upper abdomen similar to that on previous attacks, except that no vomiting was present. Nausea was present, however, with headache and a troublesome vertigo. The leucocyte count was 10,500. There was no fever. The blood amylase was 1008 on admission, and over a period of twelve to fourteen days gradually fell to a normal of 99.

At operation (by Dr. C. B. Puestow) stones were found in the gall-bladder and common duct. Fat necrosis was present. The gall-bladder was removed, as were also the stones in the common duct. A T-tube was anchored in the common duct.

Biopsy of the pancreas revealed only a slight infiltration of lymphocytes and polynuclear cells, supporting the assumption that in many instances the chief lesion in acute edematous pancreatitis is an obstructive one without any digestive action taking place (see text). Convalescence was uneventful and the patient left the hospital on her fourteenth post-operative day.

**CASE III.** E. C., female, age 36, reported the onset three years previous of an attack of pain in the upper abdomen radiating to each side

and posteriorly. The attack lasted several hours, but residual tenderness in the right upper quadrant remained for several days, and she has had numerous attacks of similar nature. Between attacks the patient had dyspepsia and noted that fried and greasy foods caused considerable distress. No jaundice at any time. Her last attack of pain started twenty-four hours before entry, and was particularly severe.

On admission, there was tenderness in the entire upper abdomen with moderate muscle spasm. After a few days the tenderness decreased, but remained most acute in the left upper quadrant. There was no fever. The leucocyte count varied from 12,000 to 16,000. The blood amylase on the day of admission, which was only twenty-four hours after the onset of the attack, was 356. Six and eight days later it had dropped to 186 and 128 respectively.

At operation the pancreas was enlarged to two and one-half times its normal size, and numerous areas of fat necrosis were found scattered about the abdomen. An area of local necrosis in the tail of the pancreas had penetrated through the mesocolon. This area of necrosis lay directly under the point where the abdominal tenderness was most acute. Stones were present in the gall-bladder and common duct. Cholecystectomy and choledochostomy were performed, and the stones removed from the common duct. The abdomen was closed without drainage.

Convalescence was slow, being complicated by a wound infection. The T-tube was left in place for ten weeks because pinching it off resulted in nausea and severe epigastric distress, indicating that previous to the tenth week post-operatively, the pancreas still offered considerable obstruction to outflow of bile, but not sufficient to produce jaundice.

CASE IV. E. M., a female 61 years of age, traced the onset of her illness to an attack of dull pain in the epigastrium three years previously. This pain gradually increased in severity and was associated with nausea and vomiting. It occurred usually in attacks lasting two or three days. Pain frequently radiated posteriorly toward the back in the midline and to the right and left as well.

At examination upon entrance to the hospital she presented definite tenderness in the epigastrium extending over the region of the pancreas. There was a mass in this area. During her stay in the hospital she had two acute

attacks of pain in the epigastrium without fever or jaundice, in the first of which a single gallstone was found in the stool, and in the second of which three gallstones were found in the stool. During each attack the blood amylase was elevated very sharply, but came down to normal within forty-eight hours. (Fig. 2.) No fever was associated with the attacks. The white blood count was 15,000.

At operation the gall-bladder was removed and the common duct drained after removal of the stones. The pancreas was found to be enlarged two or three times and indurated, although no areas of fat necrosis were found. Convalescence was uneventful.

CASE V. M. M., a female, aged 50, had been in good health until May 1937, when she noted the appearance of sharp pain in the right upper quadrant, radiating posteriorly to the scapular region. She also noted radiation of pain to the left side posteriorly, but not so severe as on the right side. She had mild pain in the right upper quadrant constantly, but also had numerous attacks when pain was much more severe. Vomiting was present occasionally during attacks. Food seemed to increase the pain. Mild constipation had been present practically since the onset of symptoms. Two weeks before entry in the hospital, the patient noticed mild jaundice.

Examination on entry revealed distinct but mild icterus. Tenderness in the right upper quadrant was acute with slight muscle spasm, and tenderness was also noted in the epigastrium, extending across into the left upper quadrant. Blood pressure was 130/80; temperature was normal. The highest white blood count was 15,000. The cholecystogram revealed no shadow.

It was quite apparent that the patient had a pancreatitis along with a cholecystitis. Blood amylase, on admission, was 1,460. High amylase persisted for fourteen days along with mild tenderness and pain in the upper abdomen. Ordinarily we would have waited for the blood amylase to return to normal, but since it remained around 1,000, and the patient appeared to be a fair operative risk, we advised operation lest the pancreatic obstruction do more severe damage to the pancreas.

At laparotomy the pancreas was found to be enlarged about three times, and was hard and nodular throughout. Several areas of fat necrosis were found. The gall-bladder was seriously

diseased, having a greatly thickened wall, but was small and contained no stones. The common duct, which was dilated, was opened, but no stones were encountered. A T-tube was placed in the common duct and the gall-bladder removed.

Recovery was uneventful, but the patient was a bit lethargic and listless and complained of troublesome weakness as if suffering from mild pancreatic asthenia. The blood amylase remained elevated for many weeks after operation, a finding which is rarely encountered.

CASE VI. E. B., female, aged 50, had had numerous attacks of pain in the right upper quadrant for the past ten years, with vomiting frequent during attacks. Ten days before entry she had another attack, consisting of pain in entire upper abdomen with radiation to the right and left posteriorly. She vomited a great deal during the first few days. Headache, vertigo and weakness were prominent symptoms. At the time of entry the patient still complained of upper abdominal pain.

Examination revealed more tenderness in the left upper than in the right upper quadrant, but only slight muscle spasm. No fever or leucocytosis was present. The blood amylase was 63 on admission, dropped to 29 a couple of days later, but gradually returned to the lower limits of normal within four or five more days.

At operation the gall-bladder was noted to contain stones and was badly diseased. It was removed. The common duct appeared normal and was not opened. Numerous areas of fat necrosis 2 to 5 mm. in diameter were noted, particularly about the pancreas, which was nodular, enlarged about two times and very edematous. An attempt was made to take a biopsy from the pancreas, but it was so friable and bled so profusely when traumatized that biopsy was not done. The liver was edematous and presented a granular surface indicating a definite hepatitis. Convalescence was uneventful and the patient left the hospital on the twelfth post-operative day. At the end of ten months, however, she was still complaining of a distressing dull pain in the epigastrium.

CASE VII. O. B., female, 25 years of age, reported the onset of the disorder eight weeks before entry, there had been severe pain in the entire upper abdomen, coming on an hour and a half after the noon meal. For a few days, she thought she had been mildly jaundiced. Within

a few days after onset, nausea and vomiting became so pronounced that she retained only water. She lost 60 pounds in eight weeks.

Examination on entrance revealed marked tenderness over entire upper abdomen with mild muscle spasm. A questionable mass was palpable in the epigastrium. Mild fever (100 degrees) persisted for ten days. The leucocyte count was 25,000. X-ray examination by barium meal revealed almost total obstruction of the duodenum. The blood amylase on admission was 31, but rose to the lower limits of normal several days later.

At operation the gall-bladder was found to contain many stones, but the wall of the fundus appeared practically normal. Many edematous vascular adhesions were present about the cystic duct, however. There was a large mass the size of one's hand occupying the region of the pancreas and extending so far into the adjacent tissue as to compress the head of the duodenum. It was edematous but not fluctuant. Although it was obviously of inflammatory origin, it was not opened because very little if any pus appeared to be present. The common duct appeared normal and was not opened. The gall-bladder was removed.

Convalescence was slow because of upper abdominal pain and a mild fever, but at time of discharge on the twenty-eighth post-operative day, the patient still complained of considerable abdominal pain which persisted with decreasing intensity for six months. At the end of this time she was apparently entirely well.

CASE VIII. I. A., female, aged 44, reported that three months before admission she had had pain in the epigastrium, radiating to each side and posteriorly; she became nauseated and vomited shortly after onset. The next day, the patient noticed that she was jaundiced. Pain and jaundice persisted for about two weeks and subsided somewhat, but not completely. During the three months prior to admission she had several attacks of pain, accompanied by fever and by occasional chills.

On entrance to hospital she was jaundiced (icterus index of 53), but had no fever. There was tenderness in the right upper quadrant and epigastrium, but no muscle spasm.

Several days after entry, she developed chills and fever, and forty-eight hours later was operated on as an emergency. Stones were palpable in the gall-bladder and common duct. Each was opened and the stones removed. The head

of the pancreas was enlarged about two times and was mildly indurated. No areas of fat necrosis were noted. A choledochostomy with a T-tube, and a cholecystostomy, were performed. The patient's serious condition did not justify removal of the gall-bladder.

Convalescence was very satisfactory except that for three weeks the jaundice lessened very

## SUMMARY

Although much confusion still exists as to the classification of acute pancreatitis, an attempt should be made to identify the type of disease, particularly since the treatment and prognosis are apt to be different in the various types. All cases of

CHART I  
SUMMARY OF CASES

Case No.	Age, Sex	Duration of Symp.	Last Attack	Max. Temp.	Max. W.B.C.	Jaundice	Operative Findings			Serum Amylase	Treatment	Remarks
							Type of Disease	Stone in G.B.	Stone in C.D.			
I	40 F	3 yrs.	4½ wks. before	101° 4 wks.	25,000	none	Acute edema	yes	yes	430 to 94	Cholecystectomy drain C.D.	Cholecystostomy 3 yrs. ago
II	38 F	2 yrs.	5 days before	norm.	11,000	none	Acute edema	yes	yes	1008 to 99	Cholecystectomy drain C.D.	Cholecystostomy 2 yrs. ago
III	36 F	3 yrs.	15 days before	norm.	16,000	none	Acute necrosis	yes	yes	356 to 126	Cholecystectomy drain C.D.	
IV	61 F	3 yrs.	in hospital	norm.	15,000	none	Acute edema	yes	yes	1400 to 54	Cholecystectomy drain C.D.	Passed gall stones in stool during attacks. See Fig. 2.
V	50 F	6 mos.	3 days before	norm.	15,000	present	Acute edema very nod.	no	no	600 to 1400 for wks.	Cholecystectomy drain C.D.	
VI	50 F	10 yrs.	10 days before	norm.	7,000	none	Acute edema	yes	no	29 to 100	Cholecystectomy	Still complaining of epigastric distress 10 mos. after operation.
VII	25 F	9 wks.	Cont. since onset	101°	24,000	none	Acute sup.	yes	no	31 to 96	Cholecystectomy	Required 6 mos. for recovery
VIII	44 F	3 mos.	Cont. since onset	103°	21,000	deep	Acute edema	yes	yes	54	Had complete block of C.D. by stones. Acute sup. cholangitis required emergency cholecystectomy and choledochostomy	

little, if any. Serum amylase four weeks after operation was slightly below normal (54). The patient continued to feel very well, having no symptoms besides jaundice. Choledochogram revealed an obstruction at the sphincter of Oddi, apparently due to the pancreas and not to stone. Shortly after this the jaundice began to lessen and within three more weeks was entirely gone. Removal of the T-tube was followed by closure of the fistula a few days later. Apparently, the obstruction of the terminal end of the common duct was produced by the pancreatitis which was slow in subsiding.

acute pancreatitis may be divided roughly into an acute edematous (interstitial) type, and an acute hemorrhagic or necrotic type. It is possible that the acute edematous type is caused primarily by obstruction, whereas the main factor in the production of the hemorrhagic or necrotic type is the development of tryptic digestion within the gland. The clinical manifestations of the two groups may be very similar indeed, except that the acute edematous type is invariably the milder and is never

associated with shock. It should be remembered that an acute pancreatitis, particularly of the edematous type, may readily be overlooked unless the pancreas is palpated. Areas of fat necrosis may likewise be overlooked unless special care is taken to search for them, particularly since they are occasionally located only along the surface of the pancreas.

The value of the blood amylase test as a diagnostic aid has been discussed. From the experiences of the author and others who are using this test, it appears that a rise in the blood amylase level is rather consistently encountered, particularly in the acute edematous type early in the disease. It is significantly true that the rise in the blood amylase may persist no longer than two or three days. The level may then fall to normal, or more commonly in the author's experience, below normal. Obviously, if the patient is not seen during the first two or three days of the attack, the blood amylase test may be of no diagnostic value. This fact must be remembered lest the test receive undue condemnation. However, the author has noted the persistence of a high blood amylase in several cases for many days after the onset of the attack.

The treatment of the acute edematous type appears definitely to be conservative. After the acute phase of the disease has receded, attention should then be directed toward operative correction of the cholecystic disease which is so frequently present in acute pancreatitis. There is difference of opinion as to the treatment of acute hemorrhagic or acute necrotic pancreatitis. Many surgeons advise immediate operation. Others advise conservative treatment and operation on the biliary tract later, as indicated. The author is inclined to favor strongly the latter method of treatment.

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DISEASES of the pancreas cannot often be diagnosed by our present methods. If greatly enlarged (tumor, cyst, hemorrhage), it may become palpable as a deep epigastric tumor, but we are rarely able to differentiate such tumors from those of the retroperitoneal structures.

From—"Physical Diagnosis" by Richard C. Cabot (William Wood).



# SURGICAL TREATMENT OF CARCINOMA OF THE AMPULLARY REGION AND HEAD OF THE PANCREAS\*

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**D**URING the past ten years a renewed interest in the surgery of malignancy of the pancreas and the ampullary region has shown itself in the surgical literature. In 1927, Cohen and Colp<sup>1</sup> gave a complete summary of the literature of the operative treatment of carcinoma of the periampullar region of the duodenum. In 1935, Whipple, Parsons and Mullins<sup>2</sup> added twenty reported cases to the fifty-nine operated cases collected by Cohen and Colp. In 1935, Hunt and Budd<sup>3</sup> collected seventy-six cases treated surgically. In 1937, Cooper<sup>4</sup> published a further review of the subject, and the latest addition to the surgery of carcinoma of the head of the pancreas is by Brunschwig,<sup>5</sup> who reports for the first time radical excision of the head of the pancreas by the two-stage method with certain modifications.

A review of these papers shows that at best the immediate results were not good

and the late results were worse. (See Table 1.) Unfortunately, many of the cases reported as surviving the surgical procedures have no follow-up data on which to base late results. But as one studies these reported cases, and especially if he has had experience in surgery of this region, the following points seem evident:

1. The efforts to remove the growth in one stage resulted fatally more often than when the operation was done in two stages.

2. The procedures, in either one or two stages, in which only a local removal of the growth was done, carried with them a higher mortality than the radical two-stage procedure with resection of the duodenum, common duct and pancreas and closure of the pancreatic stump.

3. The radical two-stage procedure carries out the principle of cancer surgery in excising *en bloc* tissues wide of the growth. In carcinomas of the ampulla this principle is applicable because extension of the growth from the papilla has been found to be either into the neighboring pancreas or up along the mucosa of the common duct.

4. The two-stage procedure is both theoretically and by experience more logical and more sound than the one-stage operation. These patients are deeply jaundiced, poorly nourished, depleted and threatened with the hazard of uncontrollable hemorrhage and shock in an extensive operation.

5. Local excision of the ampulla of Vater through the duodenum with reimplantation of the common duct carries the danger of the complication of peritonitis and duodenal fistula.

TABLE 1  
ANALYSIS OF SEVENTY-SIX CASES OF RADICAL REMOVAL  
OF AMPULLARY CARCINOMA\*

Operation	Cases	Deaths	Per Cent
Transduodenal excision.....	63	24	38
Transduodenal excision only.....	20	9	45
Transduodenal excision with reimplantation of ducts.....	19	4	21
Transduodenal excision with reimplantation of ducts with internal or external drainage.....	11	5	45.4
Transduodenal excision without reimplantation of ducts, with internal or external drainage.....	13	6	46
Resection of duodenum.....	9	3	33
Retroduodenal excision.....	4	2	50
Total to 1934.....	76	29	39.77
Survivals.....	47		61.9

\* After Hunt and Budd.<sup>3</sup>

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It was the above considerations that led us to devise the radical two-stage procedure reported before the meeting of the American Surgical Association in June, 1935 and published in the *Annals of Surgery* in October, 1935. Since then we and others have had further experience with this operation. We feel that time has demonstrated certain defects in the operation but not in the fundamental principles of radical excision *en bloc* of the tumor by a two-stage procedure. In the patients on whom we carried out the gastrojejunostomy, ligation of the common duct and cholecystogastrostomy in the first stage followed in two to three weeks, after clearing of jaundice, by the excision *en bloc* of the major portion of the duodenum and the ampulla with the lower common duct with surrounding portion of the head of the pancreas and closure of pancreatic stump, we found that a recurring cholangitis and liver infection compromised the result and shortened the probable survival of the patients who otherwise had done well.

We found that notwithstanding a large stoma made at the first operation between the gall-bladder and the stomach, a narrowing took place due to the strong contractions of the gastric musculature. This same vigorous peristalsis forced food particles and gastric secretions coming down the *Magenstrasse* into the gall-bladder and made the proper emptying of bile difficult. Stasis of infected bile favored a chronic cholecystitis and cholangitis. The lack of pancreatic secretions did not seem to impair the patients' nutrition. In fact, in two of our patients, carefully measured twenty-four hour fat intake showed that over 80 per cent of the fat was utilized and only 15 per cent could be recovered in the stools. One of these patients gained 40 pounds and the other 42 pounds and both maintained their gain.

Because of the occurrence of cholecystitis and cholangitis we have changed our plan of procedure. To shorten the first stage we intend in our next patient to ligate the

common duct below the cystic duct and do an antecolic cholecystojejunostomy on the Roux principle of anastomosing the distal

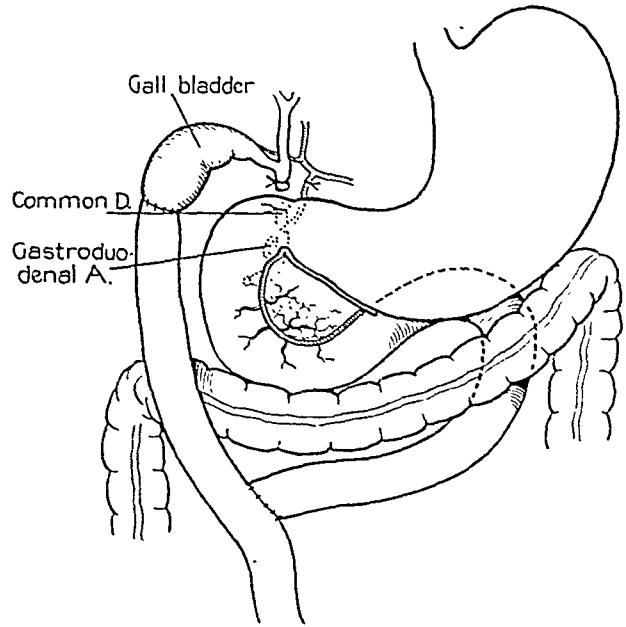


FIG. 1. First stage.

cut end of the jejunum to the fundus of the gall-bladder, with an end-to-side anastomosis of the proximal cut end of the jejunum to the side of the jejunum 10 to 12 cm. below the cholecystojejunostomy. (Fig. 1.)

After three weeks the second stage should be done, with first a gastrojejunostomy, followed by an excision of the descending or second portion of the duodenum, the ampulla of Vater with the lower end of the common duct and a wedge-shaped portion of the head of the pancreas, with ligation of the cut end of the pancreatic duct and closure of pancreatic stump. (Figs. 2 and 3.)

We believe an antecolic cholecystojejunostomy will make it easier to carry out the second stage than a posterior cholecystojejunostomy.

We have done this first stage in three patients without the development of a cholangitis. In the first of these three patients we were not certain that there was a tumor causing ampullary obstruction. The patient made such a remarkable recovery, with return to normal weight and strength that we did not urge the

second stage. He had an exceedingly responsible position in Washington, returned to his work and after six months

that the procedure is based upon a sound rationale and upon the principles of radical cancer surgery.

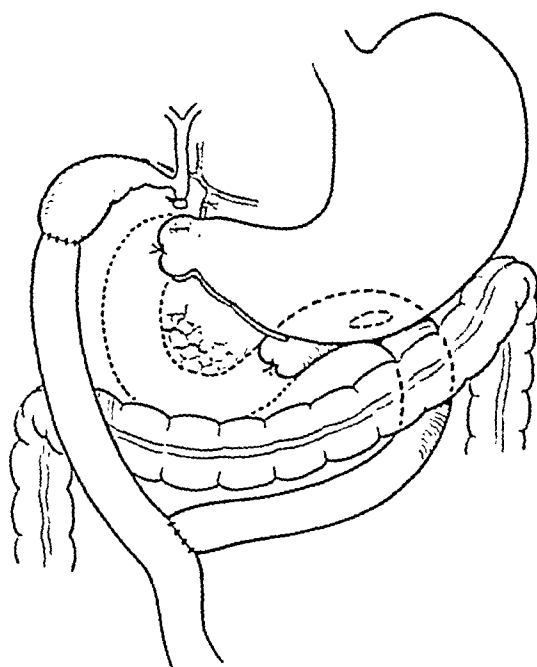


FIG. 2.

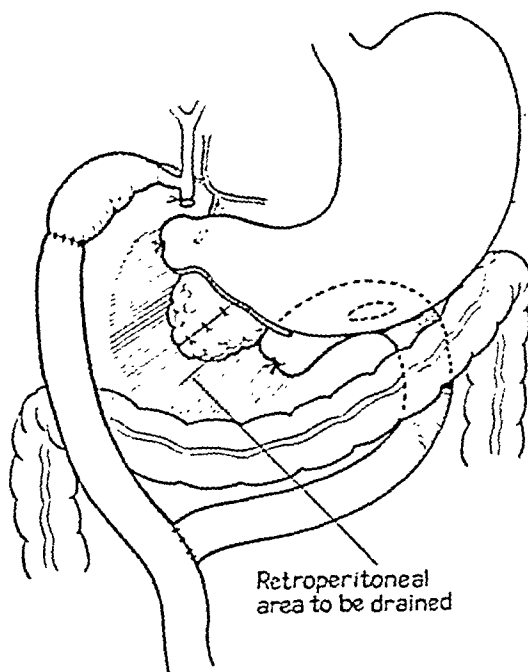


FIG. 3.

FIGS. 2 AND 3. Second stage.

of freedom from all symptoms and very active work, he suddenly had a severe hematemesis. After ten days of observation with continued occult blood in his stools, we explored him and found an infiltrating growth in his duodenum and pancreas. He died several days later. Autopsy showed a carcinoma of the head of his pancreas with metastases to his liver. But he was not jaundiced, did not have a cholangitis and his cholecystojejunostomy was functioning well.

The procedure was followed in two other patients, one with an infiltrating carcinoma of the duodenum, the other with a carcinoma of the head of the pancreas with liver metastases. These patients are still living, one and three months after operation, respectively.

This proposed procedure will have to be tried on a sufficient number of patients with a five year follow-up before any definite conclusions can be drawn as to its efficacy in dealing with what otherwise is a fatal disease. We believe, however,

Attention is again called to Brunschwig's report on pancreatoduodenectomy. In this operation he carried out for the first time the radical two-stage procedure for carcinoma of the head. He used a loop of jejunum for the gall-bladder anastomosis, with a side-to-side jejunojejunostomy. This may have advantages, but we believe the chances of constriction through the rent in the mesocolon might cause stasis, and for this reason we prefer the anterior cholecystojejunostomy on the Roux principle.

It must be realized that as a rule, the carcinomas of the head of the pancreas are much more malignant, tending to rapid metastasis to the liver, as compared with the carcinomas of the papilla and lower choledochus. However, in an early case, the differential diagnosis is impossible and for this reason attempts should be made in the small growths to carry out the two-stage procedure.

To date the writer has records of eleven such operations having been done, as follows:

*Trout* (Personal communication): The entire procedure was carried out in one stage. Patient died within a few hours after operation.

*Janes* (Personal communication): First Case: Operation was well tolerated. Patient died of pneumonia on the fifth day. Second Case: Operation successful, but patient developed a biliary fistula. Late result not known.

*Hollenberg* (Personal communication): A successful removal with a four month follow-up. A small pancreatic fistula complicated convalescence.

*Orator* (Zentralbl. f. Chir., 63: 1476, 1936): A successful removal with a three month follow-up.

*Presbyterian Hospital Series. Parsons*: Successful removal. Patient well for seven months with gain of 40 pounds. Then readmitted and died with cholangitis and multiple liver abscess.

*Whipple*: Successful removal. Living and well with gain of 30 pounds two years after operation. Has had two attacks of mild

jaundice with fever which cleared under medical treatment.

*Schullinger*: Patient died of pneumonia on second day.

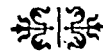
*Whipple*: Patient died of a subphrenic abscess on sixteenth day.

*Janssen*: Carcinoma of head of pancreas involving duodenum. Patient died on tenth day of asthenia and biliary fistula.

*Whipple*: Patient living and improving two weeks after operation.

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# CARCINOMA OF THE PANCREAS AND EXTRAHEPATIC BILE DUCTS\*

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## INTRODUCTION

IN spite of the many refinements in diagnostic methods and the great variety of new laboratory procedures which have been developed during the past few decades, the differential diagnosis of obstructive jaundice remains nearly as difficult as it was some fifty years ago when Courvoisier<sup>1</sup> first formulated his now famous law. This law, well known to students of medicine, is concerned with the differentiation between those obstructions of the common duct due to stones and "obstructions of other kinds." Literally translated, it is as follows: "With obstruction of the common duct by stone, dilatation of the gall-bladder is rare; the organ is usually shrunken. With obstruction of other kinds, on the contrary, distention is the rule; shrinking occurs in only one-twelfth of these cases."

For all practical purposes, "the obstructions of other kinds" referred to by Courvoisier are the cancerous obstructions due either to a primary or secondary nodule so situated that it is capable of occluding or compressing the ductus choledochus. Such obstructions caused by malignant disease are usually found in the lower portion of the duct and are ordinarily considered as being due to a primary carcinoma of the head of the pancreas. Concerning cancer in this location, Graham<sup>2</sup> has pointed out that "within an area having a radius of not more than 0.5 cm., a carcinoma may arise in any one of the following structures: (1) the ampulla of Vater; (2) the end of the common bile duct; (3) the end of the duct of Wirsung;

(4) the glandular tissue at the head of the pancreas; and (5) the duodenal mucous membrane covering the biliary papilla." In 1914, Crohn<sup>3</sup> also called attention to this fact and contended that the site of the neoplasm could usually be determined by careful examination of the duodenal contents. Moreover, the presence of carcinoma in the pancreas is not necessarily confined to the head of the gland, but as is indicated by numerous recorded instances, the neoplasm may arise from the body or tail of the organ. In such cases, jaundice may either be absent throughout the entire course of the disease, or else appear only during the late stages.

In view of the advanced stage of the disease and the hopeless condition of most of the patients applying for surgical aid, the precise point of origin of such a carcinoma may appear to be largely a matter of academic interest. However, reports of successful resections of the lower end of the common duct for cancer, usually performed by means of a transduodenal approach, have appeared fairly frequently in the recent surgical literature (Potter,<sup>4</sup> Judd,<sup>5</sup> Walters,<sup>6</sup> Hunt<sup>7</sup>). Having in mind the more elaborate surgical procedures for dealing with these lesions, such as the one proposed by Whipple, Parsons and Mullins,<sup>8</sup> and the newer methods for resection of the tail of the pancreas as suggested by Clute,<sup>9</sup> and by Rives, Romano and Sandifer,<sup>10</sup> the subject perhaps merits a renewed interest.

For these reasons the present study was undertaken. An attempt was made first, to determine the relative incidence of carcinoma in these various adjoining structures and, second, to clarify if possible

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the early clinical picture in order to facilitate diagnosis at a time when more patients might be candidates for radical surgery. Accordingly, the records of all cases of carcinoma of the pancreas and extrahepatic bile ducts, observed in the University Hospital from July 1, 1925 to July 1, 1937, were assembled for review. During this twelve year period, a final diagnosis of carcinoma of the pancreas or extrahepatic bile ducts was recorded in 158 instances. During this same period there were 246,986 patients admitted to the medical and surgical wards of the hospital. This last figure indicates only new admissions and does not include re-entries or return visits. Thus the incidence of carcinoma of the pancreas and major bile ducts among hospital patients was one in 1,563. It will be noted from Table I that in

TABLE I  
DIAGNOSIS IN 158 CASES

Method of Diagnosis	No. of Cases	Per Cent
1. Surgical operation.....	79	50.0
2. Surgical operation and necropsy....	10	6.33
3. Necropsy.....	20	12.66
4. Clinical diagnosis only.....	49	31.01
Total.....	158	100.0

forty-nine of these cases, the diagnosis was based upon clinical data only. Because of the possibility of mistaken diagnoses in this group, it was believed that the study would be of greater value if only those cases in which the diagnosis was verified by operation or necropsy, were utilized for the statistical survey. Accordingly the detailed study was limited to the remaining 109 case records. It will be noted that there were seventy-nine operative diagnoses and thirty necropsy diagnoses.

Table II gives the anatomic location of the primary lesion as it was determined by the operating surgeon or prosector. According to these observations, the lesion involved the head of the pancreas, either

alone or as part of a more extensive process, in nearly 60 per cent of the cases, while the body of the gland, alone or along with the head or tail or both, was affected in 30 per cent of the group. Carcinoma of the common duct, including the ampulla of Vater, was found in approximately 17 per cent. Thus from these data which were obtained chiefly at the operating table, the head of the pancreas was found to be

TABLE II  
LOCATION OF PRIMARY LESION IN 109 VERIFIED CASES

Location	No. of Cases	Per Cent
1. Head of pancreas.....	49	44.95
2. Body of pancreas.....	14	12.84
3. Head and body of pancreas.....	7	6.42
4. Tail of pancreas.....	1	0.92
5. Body and tail of pancreas.....	3	2.75
6. Entire pancreas.....	9	8.26
7. Common duct.....	9	8.26
8. Ampulla of Vater.....	9	8.26
9. Hepatic duct.....	4	3.67
10. Cystic duct.....	4	3.67
Total.....	109	100.0

affected more frequently than any other single region, while a primary carcinoma of one of the major bile ducts was noted in about one-fourth of the cases. As will be emphasized later, at the time of operation it is frequently impossible to determine by palpation alone the exact site of the primary lesion. This is especially true in the advanced cases when contiguous structures have been involved, and in such cases the exact point of origin can only be told with certainty by post-mortem examination with histological study of the tissues.

#### AGE AND SEX INCIDENCE

Table III shows the distribution of the 109 cases according to sex and age. The ratio of men to women was approximately two to one. These findings are in accord with those of other observers (Mirallie,<sup>11</sup> DaCosta,<sup>12</sup> Speed,<sup>13</sup> Fitcher,<sup>14</sup> Ancelot,<sup>15</sup> Leven,<sup>16</sup> and Friedenwald and Cullen<sup>17</sup>). Rienhoff and Lewis<sup>18</sup> found a somewhat

higher incidence among males (3:1) as did Rives, Romano and Sandifer (4.3:1), while in Kiefer's<sup>19</sup> series of thirty-three cases, there were 18 males and fifteen females.

TABLE III  
AGE AND SEX INCIDENCE

Sex	No. of Cases	Per Cent
Sex Incidence		
Males.....	75	68.81
Females.....	34	31.19
Total.....	109	100.0
Distribution of Cases According to Age		
Age	No. of Cases	Per Cent
20-29	1	.91
30-39	5	4.59
40-49	16	14.68
50-59	42	38.54
60-69	34	31.20
70-79	10	9.17
80-89	1	.91
Total.....	109	100.

The youngest patient was 29 years old and the oldest 82 years; the average age was 56.9 years.

With regard to the age distribution, it will be noted that nearly 85 per cent of the patients were in the so-called cancer age, i.e., between 40 and 70, and that the disease was quite uncommon in patients under 40. The average age for the group was 56.9 years.

#### CLINICAL MANIFESTATIONS

##### HISTORY

**Weight Loss.** Loss of weight was the symptom common to the largest number of patients; it was absent in only five of the ninety-five cases in which the records were complete on this score. Definite mention of weight loss was therefore found in 94.74 per cent. The weight loss was usually rapid and frequently considerable, as is shown in Table IV, where it is seen that the amount

in nearly one-seventh of the cases exceeded 40 pounds (18.2 kg.) and in the one case in which the greatest loss was recorded,

TABLE IV  
WEIGHT LOSS IN 95 CASES

Number of Pounds Lost	No. of Cases	Per Cent
1. None.....	5	5.26
2. 1-10 pounds incl.....	4	4.21
3. 11-20 pounds incl.....	20	21.05
4. 21-30 pounds incl.....	22	23.16
5. 31-40 pounds incl.....	14	14.74
6. 41-50 pounds incl.....	6	6.32
7. 51-60 pounds incl.....	6	6.32
8. 61-70 pounds incl.....	0	
9. 71-80 pounds incl.....	1	1.05
10. History of definite weight loss amount not recorded.....	17	17.89
Total.....	95	100.0
Records incomplete.....	14	
Greatest weight loss recorded—76 pounds (34.6 Kg.).....		
Average weight loss—30.3 pounds (13.8 Kg.).....		

amounted to 76 pounds (34.6 kg.). The average amount of weight lost in the seventy-three cases in which definite figures were available was 30.3 pounds (13.8 kg.). These figures are approximately the same as those reported by other observers. Thus Kiefer found the average weight loss in his series to be 28 pounds, Levin 32 pounds, Hick and Mortimer<sup>20</sup> 37 pounds, Fitcher 32 pounds, Eusterman<sup>21</sup> 29 pounds and Mussey<sup>22</sup> 26 pounds. Considering the fact that the average duration of symptoms was 5.5 months, the average weight loss per month amounted to 5.5 pounds (2.5 kg.). This is practically the same as Kiefer found in his Brigham Hospital series. Since loss of weight is such a general symptom and one found in such a variety of chronic conditions, particularly malignant disease, its presence is not of great diagnostic import. The most significant feature of weight loss in pancreatic cancer is the extreme degree of the emaciation and the rapidity of its development.

**Jaundice.** Table V indicates the relative frequency of the other symptoms com-

monly ascribed to carcinoma of the pancreas. It will be noted that with the exception of weight loss, jaundice occurred

TABLE V  
FREQUENCY OF COMMON SYMPTOMS

Symptoms	No. of Cases	Per Cent
1. Jaundice.....	83	76.15
2. Pain.....	72	66.06
3. Weakness.....	49	44.95
4. Constipation.....	40	36.70
5. Nausea and vomiting.....	32	29.36
6. Diarrhea.....	14	12.84
7. Nausea.....	11	10.09
8. Vomiting.....	5	4.59

with greater frequency in the history than any of the other symptoms, it being a definite complaint in eighty-three cases, or 76.15 per cent of the group. Jaundice alone was the chief complaint and the one for which medical advice was sought in thirty-nine cases, or 35.78 per cent (Table VI). If to this are added those cases in

TABLE VI  
CHIEF COMPLAINTS

Complaint	No. of Cases	Per Cent
1. Jaundice.....	39	35.78
2. Abdominal pain.....	30	27.52
3. Jaundice and abdominal pain....	15	13.76
4. Jaundice and weakness.....	9	8.26
5. Weakness and weight loss.....	6	5.50
6. Abdominal pain and tumor.....	2	1.83
7. Weakness and abdominal pain...	2	1.83
8. Abdominal pain, tumor and jaundice.....	1	.92
9. Abdominal tumor.....	1	.92
10. Pruritus.....	1	.92
11. Nausea and vomiting.....	1	.92
12. Increasing constipation.....	1	.92
13. Ascites.....	1	.92
Total.....	109	100.0

which jaundice occurred as the chief complaint in combination with other symptoms, the total is sixty-four cases, or 58.72 per cent, and in combination with abdominal pain was the initial complaint in two additional cases. Pruritus was men-

tioned in thirty-seven, or 44.6 per cent of the jaundiced cases and occurred once as the chief complaint and once as the initial symptom.

**Pain.** Contrary to the usual statement that the clinical picture of carcinoma of the pancreas is one of progressive painless jaundice, pain was a prominent symptom in this series, as it occurred in two-thirds of the cases. In the non-icteric patients, notably those with lesions in the body or tail of the pancreas, it was almost always the chief complaint as well as the initial symptom. It was a major symptom in all such cases. A separate report of these cases has been made previously by the author.<sup>23</sup>

In the group of cases now under consideration, abdominal pain alone was the chief complaint in thirty cases, or 27.52 per cent, while pain in conjunction with jaundice, tumor mass or weakness, was the chief complaint in twenty more cases, or 18.34 per cent. Thus it appeared in the chief complaints in fifty cases, or 45.86 per cent of the group. As shown in Table VII,

TABLE VII  
INITIAL SYMPTOMS

Symptom	No. of Cases	Per Cent
1. Abdominal pain.....	51	46.80
2. Jaundice.....	27	24.77
3. Weakness.....	14	12.84
4. Nausea and vomiting.....	7	6.42
5. Diarrhea.....	3	2.75
6. Jaundice and abdominal pain....	2	1.83
7. Increasing constipation.....	2	1.83
8. Pruritus.....	1	.92
9. Abdominal tumor.....	1	.92
10. Ascites and pain.....	1	.92
Total.....	109	100.0

abdominal pain alone was the most common initial symptom, being the first evidence of departure from normal health to be noted by the patient in nearly one-half of the cases. The frequent occurrence of abdominal pain in pancreatic carcinoma has been emphasized by other writers. Thus Rienhoff and Lewis in their



review of the Johns Hopkins Hospital cases reported it in 87.16 per cent; Rives, Romano and Sandifer in 77.4 per cent; Kiefer in 63.6 per cent; Friedenwald and Cullen in 83 per cent; Fitcher in 58 per cent; Mussey in 88 per cent; and Levin in all of the cases studied.

Elaborate descriptions are to be found concerning the character or type of pain in pancreatic cancer. In general they may be summarized as follows: (1) a boring or burning steady pain located in the mid-epigastrium and sometimes radiating into the back; (2) a colicky pain in the right upper quadrant, possibly with radiation to the right shoulder, and quite capable of simulating gallstone colic; and (3) a paroxysmal type of pain beginning at or near the umbilicus.

Such pain may be influenced by various factors. Thus relief is sometimes obtained by change in position, such as leaning forward, lying in the prone position, by the ingestion of food or soda, by vomiting, or by defecation.

Various explanations have been offered to account for the pain. Among these are obstruction to the pancreatic or bile ducts, thus producing stasis of pancreatic secretion or bile, mechanical pressure on the celiac plexus, and direct infiltration of the pancreas associated with hemorrhage and pancreatitis. Leven reports one case in which post-mortem examination of the tissues in the region of the celiac plexus showed infiltration of the sympathetic nerve trunks by tumor tissue, resulting in marked compression of these nerves. The lower half of the celiac plexus is closely associated with the posterior surface of the body of the pancreas and many nerve fibers leaving the plexus perforate the substance of the pancreas. Considering the fact that pain is especially severe in carcinoma of the body of the gland, and that the lesion is usually well advanced before symptoms appear, mechanical pressure or direct infiltration of nerve sheaths or of the nerve trunks themselves seems to be a plausible explanation.

In Tables VIII and IX an attempt has been made to tabulate the location and character of the pain in the seventy-two

TABLE VIII  
LOCATION OF PAIN IN 72 CASES

Location	No. of Cases	Per Cent
1. Right upper quadrant.....	21	29.17
2. Mid epigastrium.....	19	26.39
3. Generalized over abdomen.....	7	9.72
4. Lower abdomen.....	6	8.33
5. Entire upper abdomen.....	5	6.94
6. Right upper quadrant and back..	5	6.94
7. Epigastrium and back.....	4	5.56
8. At umbilicus.....	3	4.17
9. Left upper quadrant.....	1	1.39
10. Low back.....	1	1.39
Total.....	72	100.0

TABLE IX  
TYPE OF PAIN IN 72 CASES

Type of Pain	No. of Cases	Per Cent
1. Steady aching pain.....	36	50.0
2. Attacks of colic.....	24	33.33
3. Steady with intermittent colic.....	8	11.11
4. Intermittent aching pain.....	4	5.56
Total.....	72	100.0

cases in which it was present. While the location was far from constant, the right upper quadrant and the mid-epigastrium were the regions most frequently mentioned. A steady aching pain occurred in one-half of the patients complaining of pain. The most striking characteristic was the unusual severity of the pain, especially in the non-jaundiced cases, obviously much worse than the pain of peptic ulcer, gastric carcinoma or cholecystitis. In one-third of the cases, the pain occurred in attacks of colic and being often located in the right upper quadrant, as well as frequently being accompanied by jaundice, it occasionally resulted in an incorrect diagnosis of cholelithiasis or common duct stones. In eight

cases, there was the steady type of pain, with superimposed attacks of colic, while in four cases the pain, while not of the colicky type, was nevertheless intermittent in character.

*Weakness.* From Table v it will be noted that next to jaundice and pain, a complaint of loss of strength occurred most often. Marked weight loss is usually accompanied by loss of strength, and therefore in all probability weakness occurred in the majority of the patients. However, in 45 per cent of the group, the asthenia was so marked that it constituted an important complaint.

*Constipation and Diarrhea.* In over one-third of the cases constipation was a definite symptom, while diarrhea was specifically mentioned in one-eighth. While constipation is of such common occurrence in patients of this age group that its presence may not be of great diagnostic significance and might be regarded as purely incidental, nevertheless a reading of these case histories convinces one that there was frequently an exaggeration of previous chronic constipation. Even though it had not previously been troublesome, when it developed during the course of the disease it was particularly marked. This latter finding is of considerable practical interest, especially in the non-jaundiced patients, inasmuch as severe constipation, when found in a patient of middle age, associated with weight loss, abdominal pain, the presence of occult blood in the stools and indeterminate findings on roentgenologic examination of the colon, may lead to a mistaken diagnosis of carcinoma of the colon.

From the standpoint of diagnosis, diarrhea was less significant. While in the presence of jaundice the stools were acholic or hypocholic, the large, bulky, buttery stools said to result from the absence of the external secretion of the pancreas were not mentioned. Recent experimental work and clinical observations indicate that a large portion of the fats of ingested food can be utilized in the complete absence of

pancreatic secretion (McClure, Vincent and Pratt,<sup>24</sup> Whipple, et al.).

*Nausea and Vomiting.* Nausea, vomiting or both occurred with some frequency, being present in nearly one-half the cases. Various explanations have been given to account for the occurrence of these symptoms. Among them are stimulation of the branches of the vagus, exclusion of bile and pancreatic secretions from the intestine, neoplastic invasion of the gastrointestinal tract, or mechanical obstruction of the pylorus or duodenum from extrinsic pressure by neoplasm. In comparing this mixed group of cases with that of carcinoma of the body and tail of the pancreas, the incidence of nausea and vomiting was found to be considerably greater in the mixed group, composed as it was of a majority of jaundiced patients. In the previously reported group where biliary tract obstruction was absent, it was observed that nausea and vomiting were not frequent symptoms and when present were usually an accompaniment of paroxysms of pain and not important independent symptoms. Thus the suggestion that lack of bile and pancreatic juice are in part at least responsible seems plausible.

Of the thirty cases coming to necropsy (see below) neoplastic invasion of the gastrointestinal tract was noted in only eight cases and actual mechanical obstruction in only two. On the other hand, in the list of the eighty-nine operative cases, the findings were such in eight instances that in the judgment of the operator mechanical pyloric or duodenal obstruction sufficient to warrant posterior gastroenterostomy did exist. Similarly Rienhoff and Lewis reported that posterior gastroenterostomy was performed four times in 106 operations for carcinoma of the pancreas. Rives, Romano and Sandifer conclude that the explanation of nausea and vomiting probably lies in the direct involvement by neoplasm of the pancreas itself.

*Duration of Symptoms.* In Table x are shown the intervals of time, elapsing between the onset of symptoms and the

time of admission to the hospital. The shortest period of illness recorded was two weeks and the longest three years. In view

TABLE X  
DURATION OF SYMPTOMS

Duration	No. of Cases	Per Cent
1. Under 1 month.....	9	8.26
2. 1-3 months incl.....	37	33.95
3. 4-6 months incl.....	37	33.95
4. 7-9 months incl.....	10	9.17
5. 10-12 months incl.....	10	9.17
6. 13-24 months incl.....	4	3.67
7. Over two years.....	2	1.83
Total.....	109	100.0

Shortest duration of symptoms—two weeks.

Longest duration of symptoms—three years.

Average duration of symptoms—five and five-tenths months.

of the notoriously rapid progress and relatively short life history of the disease, the histories of illness lasting over one year are perhaps open to some question. In such cases, it is quite possible that symptoms of antecedent chronic abdominal disease, such as chronic cholecystitis, cholelithiasis or peptic ulcer, may have merged with the earliest symptoms of the carcinoma.

It will be noted from the table that in 75 per cent of all of the cases the symptoms were of less than six months' duration, the average duration for the entire group being 5.5 months. It is interesting to compare this figure with the average duration of symptoms of 5.7 months in the earlier report concerning carcinoma of the body and tail of the pancreas. Thus since these two figures are practically identical, the duration of symptoms in this larger group including many patients with jaundice was almost precisely the same as in the group of cancer of the body and tail of the pancreas only.

Since this average time interval between the beginning of symptoms and the time of hospital admission is much shorter than in the case of patients with many other types of carcinoma (of the breast or the

rectum, for example) it might seem encouraging from the standpoint of treatment. As a matter of fact most of the cases were far advanced, as indicated by the necropsy group of thirty cases in which a lesion capable of being extirpated was found in only eight instances. The short duration of symptoms merely serves to emphasize the rapid progress of the disease.

*Past History.* Regarding previous diseases of the digestive tract which might have an etiologic bearing on the present trouble, the histories were relatively barren. Two patients gave a characteristic story of gall-bladder disease and four had had operations upon the biliary tract. Six patients gave a history of diabetes mellitus of long standing.

TABLE XI  
POSITIVE FINDINGS NOTED ON PHYSICAL EXAMINATION  
IN 109 CASES

Physical Signs	No. of Cases	Per Cent
1. Jaundice.....	84	77.06
2. Emaciation.....	74	67.89
3. Hepatic enlargement.....	65	59.63
4. Abdominal tenderness.....	65	59.63
5. Abdominal tumor.....	42	38.53
6. Distended gall-bladder.....	17	15.60
7. Edema.....	17	15.60
8. Ascites.....	12	11.01
9. Dilatation of superficial veins of abdomen.....	8	7.34

*Family History.* The records of the family history as far as cancer was concerned were not very illuminating. Such histories, of course, are open to objection on the grounds of inaccuracy. In the present group of 109 cases, fourteen gave a history of cancer in the parents or grandparents or among siblings. The site of the lesion in these cases was so varied as to be of little interest and to have no practical bearing.

#### PHYSICAL EXAMINATION

In Table XI are shown in the order of frequency of their occurrence the positive findings noted on physical examination.

*Jaundice.* This was the most common finding in the 109 cases, being present in 77 per cent. This observation is almost identical with those of Kiefer, Fitcher, Leven, Friedenwald and Cullen, and Rives, Romano and Sandifer. Rienhoff and Lewis found jaundice in 69.22 per cent of their cases, while Mussey reported it in only 41 per cent and Eusterman in 46 per cent. When present it is usually marked. This is attested to by the fact that eighty-three of the eighty-four jaundiced patients were aware of its existence and had mentioned it as one of their complaints.

*Emaciation.* Emaciation was recorded in seventy-four instances. In view of the history of considerable weight loss in the majority of cases, this number is probably unduly low. Undoubtedly emaciation of some degree was usually present, but was noted in the case record only when it was extreme.

*Hepatic Enlargement.* Enlargement of the liver was detected on clinical examination in 60 per cent of the cases. Obstructive jaundice is a well-known cause of hepatomegaly, as is also carcinoma of the liver. In the thirty cases coming to necropsy, hepatic metastases were found in thirteen.

*Abdominal Tumor.* An abdominal tumor mass other than the enlarged liver or the distended gall-bladder was noted in 39 per cent of the cases. A palpable tumor is found more frequently in the cases of cancer of the body or tail of the pancreas than in those of the head of the gland. In our series of cancers of the body and tail, a palpable tumor was present in 50 per cent of the cases. Abdominal tumors were described by Friedenwald and Cullen, Kiefer and Fitcher in 43.25, and 27.27 and 57.14 per cent of their cases, respectively.

*Distended Palpable Gall-Bladder.* In accordance with Courvoisier's law, a palpable, distended gall-bladder in the presence of jaundice should be pathognomonic of cancerous obstruction of the biliary tract. As shown in Table XI this finding did not prove to be of great assistance in arriving at a correct diagnosis, as the gall-bladder

was palpable in only 15.6 per cent of the series. It is true that this group includes fourteen cases of carcinoma of the body and one of the tail of the pancreas and three of the body and tail, in all of which jaundice was absent. Likewise, in the four cases each of carcinoma of the hepatic and of the cystic ducts, the usual mechanism of back pressure in the bile ducts and gall-bladder would be lacking. Moreover, even though the gall-bladder is actually enlarged or distended, as subsequently revealed at operation or necropsy, it is frequently overlapped by the enlarged right lobe of the liver, so that the examiner fails to recognize it. In the thin patients, when a palpable gall-bladder was present, the enlarged viscus could usually also be observed on inspection of the abdomen, appearing as a globular swelling in the right upper quadrant. Rives, Romano and Sandifer report a somewhat similar experience in that the gall-bladder was palpated in only twenty-seven of their ninety-six cases prior to operation. On the other hand, Kiefer, Mussey, Eusterman, Kehr,<sup>25</sup> Leven and Friedenwald and Cullen found palpable gall-bladders in from 50 per cent to 88 per cent of their cases.

*Abdominal Tenderness.* Abdominal tenderness was present in 60 per cent of the cases. It was rarely sharply localized and aided but little in the diagnosis. The incidence is essentially the same as that reported by other observers.

Edema, ascites and dilatation of the superficial veins of the abdomen were occasionally encountered. All were noted in patients with far advanced disease.

#### LABORATORY EXAMINATIONS

*Urine.* Urine analyses were recorded in all of the 109 cases under consideration. Dextrose was present in nine instances, in six of which there was a definite history of diabetes of fairly long duration, with blood sugar curves which confirmed the diagnosis. Glycosuria due to carcinoma of the pancreas per se appears to be an

uncommon finding. Likewise the association between pancreatic carcinoma and diabetes mellitus seems to be purely coincidental, as six of the nine glycosuric patients were known diabetics. Thus, Kiefer points out that diabetes is quite frequent in the fifth and sixth decade of life and that in a similar number of persons of the same age as those having carcinoma of the pancreas, taken at random from the general population, there would be an appreciable number of diabetics. He also calls attention to the fact that liver damage resulting from biliary obstruction, infection, or involvement of the liver by metastatic carcinoma may alter carbohydrate metabolism. Experimental work along these lines has been reported by Coller and Troost<sup>26</sup> and clinical evidence by Conn and Newburgh.<sup>27</sup>

Bile was present in the urine of sixty-eight of the jaundiced cases, but unfortunately, in the remainder of these cases, the examination of the urine for bile was not reported.

The urine contained microscopic blood in sixteen cases, and in two there was gross hematuria. Bilirubinuria is often accompanied by albuminuria, due to renal irritation. The presence of microscopic blood may be explained on this basis in some cases.

Involvement of any portion of the urinary tract by neoplasm was a rare finding in the thirty cases examined postmortem. In only one was such involvement noted, and in this there was direct extension of a pancreatic cancer into the left kidney, adrenal and ureter.

**Stools.** Examination of the stool was reported in ninety-four of the cases. Clay-colored stools were observed in fifty-two instances and gross blood was present in two. Occult blood, as demonstrated by the guaiac or benzenide tests, was found in thirty-four.

**Gastric Analysis.** Analysis of the stomach contents was made in fourteen cases. Hypoacidity or anacidity was present in ten cases, hyperacidity in one, while

normal values were obtained in the remaining three.

**Blood.** Hemoglobin readings were recorded in 102 cases. The highest reading was 110 per cent and the lowest 24 per cent with an average determination of 74 per cent. (All of these determinations were made by the Sahli method.) Erythrocyte counts were made in seventy-seven cases: the maximum number was 6,400,000 and the minimum 2,000,000, with an average of 4,030,000.

The leucocyte count was recorded in 102 cases. The highest determination was 23,800, an exceptional finding. The lowest determination was 2,100, and the average 6,500.

In this connection, it may be noted that the average temperature during the hospital stay or during the pre-operative period in the case of the patients operated upon, was under 100°F. in ninety-six cases and over 100°F. in only thirteen. Blood studies in general showed nothing characteristic which was of diagnostic value. It is interesting to note that in spite of the marked cancer cachexia so frequently noted, only a moderate degree of secondary anemia existed.

**Blood Sugar.** A determination of the fasting blood sugar was carried out in thirty-five cases. Readings above 120 mg. per cent were noted in six cases, the highest reading being 290. These six cases all gave a definite history of diabetes and the glucose tolerance test showed a typical diabetic curve. Of the remaining thirty cases, the highest fasting blood sugar determination was 110 mg. per cent and the lowest 59, the average being 88.1.

**Non-Protein Nitrogen.** Determination of the blood non-protein nitrogen was made in twenty-five cases, in only two of which were the readings over 40 mg. per cent, these being 48.2 and 75.9 respectively. Of the remainder, the lowest reading was 27.5 and the highest 40, the average being 33.5.

**Blood Bilirubin.** Blood bilirubin readings were made in only three of the non-

jaundiced patients and in fifty-seven of the jaundiced patients. In the latter group the highest reading was 180 mg. per 1000 c.c. and the lowest 8, with an average reading of 70.6.

*Wassermann and Kahn Reactions.* The blood Wassermann or Kahn test for syphilis was recorded in ninety-three of the 109 cases, with the Wassermann reaction employed in the earlier cases and the Kahn test in the more recent ones. Of the thirteen Wassermann tests, the reaction was negative in ten, positive in two and questionable in one. Of the eighty reports on the Kahn reaction, there were seventy-nine which were negative and one positive. Thus in these ninety-three cases there were only three, or 3.2 per cent, which showed strongly positive tests. These findings tend to refute the statement that syphilis is an etiologic factor in carcinoma of the pancreas.

The remarkable thing about all of the laboratory studies was the fact that practically all of the findings were well within normal limits with the exception of the blood bilirubin determinations in the cases with jaundice. It is, in fact, surprising that more departures from the normal were not found in the various laboratory examinations. The only exception is, of course, in the cases with questionable jaundice in which an elevation of the bilirubin content of the blood may be of significance.

*Roentgen Findings.* Of considerably greater interest and value in diagnosis were the results of the roentgenologic examination. Such a study by means of the barium meal, with or without the examination of the colon by the barium enema, was made in ninety-three cases. Table XII gives the results of these studies. While the examination was entirely negative in three-fourths of the cases, it is significant that in the remaining one-fourth the findings were such that a pancreatic tumor was suspected or even a positive diagnosis ventured. The important positive findings were a widening of the normal duodenal curve, narrowing of the duodenal lumen or indentation

of the shadow of the duodenum or stomach by pressure from without. In an indirect way, the examination was also of value in excluding carcinoma of the stomach or of the colon, both of which lesions may easily be confused with carcinoma of the pancreas, especially when jaundice is absent.

TABLE XII  
ROENTGEN FINDINGS IN 93 CASES

Results of Examination	No. of Cases	Per Cent
1. Negative.....	69	74.20
2. Pancreatic tumor suspected.....	16	17.20
3. Positive findings of the type found in pancreatic cancer .....	8	8.60
Total.....	93	100.0
No examination .....	16	
Total.....	109	

A matter of some scientific interest was the cholecystographic response. In the group of twenty-five non-icteric patients, cholecystography was employed nine times with the following results: non-visualization of the gall-bladder in five, normal visualization without stone in three and an unsatisfactory test in one. The examination was made in fifty-six of the eighty-four jaundiced cases. The results were: complete non-visualization of the gall-bladder—forty-nine; faint visualization—two; normal visualization without stone—three; and an unsatisfactory examination in two.

#### DIAGNOSIS

In summarizing the foregoing remarks, it may be stated that in the presence of obstructive jaundice, the differential diagnosis of cancer of the head of the pancreas or bile ducts is frequently exceedingly difficult, even with the assistance of all of the available laboratory data and roentgenologic studies.

When the classical Courvoisier-Terrier syndrome or the syndrome of Bard and Pic<sup>28</sup> is present, little difficulty is encountered. These syndromes are characterized

by progressive persistent and painless jaundice, dilatation of the gall-bladder, acholic stools, and associated cachexia. In the present study, such a clinical picture was unusual. On the contrary, pain was a prominent symptom, and being commonly situated in the upper abdomen or right upper quadrant, as well as tending to occur in attacks or paroxysms, it often simulated the picture of common duct stones or carcinoma of the gall-bladder. Even in carcinoma of the pancreas or bile ducts, definite remissions in the jaundice may occur, although it is rare for it to disappear completely at any time. The relatively short history and the marked evidence of bodily deterioration are perhaps the most important findings favoring a diagnosis of pancreatic cancer.

TABLE XIII  
PRE-OPERATIVE DIAGNOSES IN PATIENTS WITH JAUNDICE

Diagnosis	No. of Cases	Per Cent
1. Carcinoma of the pancreas.....	48	66.66
2. Common duct stones.....	13	18.06
3. Carcinoma of bile ducts or gall-bladder.....	7	9.72
4. Portal cirrhosis.....	1	1.39
5. Subacute cholecystitis.....	1	1.39
6. Duodenal ulcer with obstructive jaundice.....	1	1.39
7. Stenosis of cholecystoduodenostomy stoma (previous operation elsewhere for chronic pancreatitis(?)).....	1	1.39
Total.....	72	100.0

Table XIII presents the clinical diagnoses made prior to operation in the seventy-two jaundiced patients upon whom laparotomies were performed.

It will be noted that a correct diagnosis of cancer of the pancreas or bile ducts was made in over two-thirds of the cases and that the most frequent mistaken diagnosis was common duct stones. As a matter of fact, common duct stones coexisted with cancer in two instances. In one, the primary lesion was in the head of the pancreas

and was easily recognized at the time of operation, while in the other it was in the lower end of the common duct. In the latter case, the duct and gall-bladder contained white bile. In this case, the common duct carcinoma was not discovered until necropsy and microscopic examination of the tissues.

When jaundice is absent, the difficulties in diagnosis are greater and, as indicated in Table XIV, a correct pre-operative

TABLE XIV  
PRE-OPERATIVE DIAGNOSES IN PATIENTS WITHOUT JAUNDICE

Diagnosis	No. of Cases	Per Cent
1. Carcinoma of the pancreas.....	7	41.19
2. Carcinoma of the stomach.....	3	17.65
3. Carcinoma of the colon.....	2	11.76
4. Duodenal obstruction—probably due to carcinoma.....	2	11.76
5. Cyst of pancreas.....	1	5.88
6. Cholelithiasis.....	1	5.88
7. Benign pyloric obstruction.....	1	5.88
Total.....	17	100.0

diagnosis of cancer of the pancreas was made in only 41 per cent of those cases. However, if the two cases in which a diagnosis of duodenal obstruction due to cancer was made are included, a reasonably correct diagnosis was made in slightly over 50 per cent of the cases. As shown in the table, cancer of the pancreas without jaundice, usually a carcinoma of the body or tail of the organ, was more often confused with carcinoma of the stomach or of the colon than with any other lesion. In these non-icteric patients, the main symptom was severe abdominal pain, often occurring in paroxysms or crises, and associated with rapid and extreme emaciation. Roentgen studies of the gastrointestinal tract were at least suggestive in one-quarter of the cases. With the rapid advances being made in the field of roentgenology, this method bids fair to be of much greater assistance in the future.

## OPERATIVE FINDINGS

Surgical operations were performed upon eighty-nine of the 109 cases under consideration. At the time of operation, jaundice was present in seventy-two or 80.9 per cent of this surgical group, while seventeen, or 19.1 per cent, were free from jaundice. In the group of jaundiced patients, as shown in Table xv, a distended gall-bladder

TABLE XV  
CONDITION OF GALL-BLADDER AT TIME OF OPERATION  
(89 CASES)

Condition of Gall-bladder	No. of Cases	Per Cent
Patients with Jaundice (72 Cases)		
1. Distended.....	48	66.66
2. Walls thickened and gall-bladder distended.....	12	16.67
3. Walls thickened—gall-bladder not distended.....	6	8.33
4. Normal.....	3	4.17
5. Contracted—containing stones....	1	1.39
6. Buried in adhesions and surrounded by carcinoma.....	1	1.39
7. Previous cholecystoduodenostomy.	1	1.39
Total.....	72	100.0
Patients without Jaundice (17 Cases)		
1. Normal.....	7	41.19
2. Slightly distended.....	5	29.41
3. Walls thickened—not distended...	2	11.76
4. Contracted—containing stones....	2	11.76
5. Undetermined.....	1	5.88
Total.....	17	100.0

was found in sixty cases, or 83 per cent. In forty-eight of these, the gall-bladder wall appeared to be quite normal, while in twelve it was definitely thickened, apparently due to circulatory changes such as congestion and edema rather than fibrosis from chronic inflammation.

While in one case a cholecystoduodenostomy had previously been performed in an outside hospital, and in four of the cases the carcinoma was situated in the hepatic duct, the figure 83 per cent seems to be a fair statement of the accuracy of Courvoisier's law.

In two of the cases of carcinoma of the hepatic duct, a collapsed and empty gall-bladder was noted. Although a collapsed gall-bladder is rarely seen at the time of operation, it may be present under the above-mentioned circumstances. A tumor of the hepatic duct may prevent bile from entering the cystic duct and the usual mechanism responsible for the filling of the gall-bladder is thus interfered with.

In our experience, Courvoisier's law has proved to be of much greater value to the surgeon at the time of the laparotomy than to the clinician during the physical examination. Thus at the time of operation the presence of a distended gall-bladder, usually associated as it is with dilatation of the duct system, is indicative of an obstruction, probably neoplastic, at the lower end of the common duct and calls for a careful investigation of this region.

It will be noted that there was a rather marked discrepancy between the number of palpable gall-bladders detected prior to operation and the number found to be distended when the abdomen was opened. While this may be explained in part by lack of sufficient care on the part of the examiner, it is also true that a distended gall-bladder may escape notice in the case of a thick abdominal wall, especially when there is marked enlargement of the right lobe of the liver with overlapping of the gall-bladder.

Of considerable interest in both the icteric and non-icteric patients was the frequent finding of inflammatory lesions of the gall-bladder with or without stones. Thus, of the eighty-nine cases operated upon, there were eleven in which the gall-bladder wall was thickened and in which distention was absent. In three of these cases stones were present. Further evidence on this score was obtained from biopsy specimens taken at the time of operation. When anastomoses between the gall-bladder and gastrointestinal tract were made, or when cholecystostomy was performed, a small bit of the gall-bladder was taken for microscopic examination on



thirteen occasions. The histologic examination of the material showed invasion of the gall-bladder by carcinoma in two, and the remaining eleven showed chronic cholecystitis.

The nature of the gall-bladder contents is also of interest. In the entire group of eighty-nine surgical cases, stones were present in the gall-bladder in fifteen instances and in one an empyema of the gall-bladder was present as well. Thus in the present series there was a fairly high incidence of concomitant or antecedent infection of the biliary tract which may or may not have played a part in the subsequent development of the neoplasia.

As mentioned above, stones were encountered in the common duct on two occasions. In one, the carcinoma was of the ampulla and in one it was in the head of the pancreas. As a rule, carcinoma of the bile ducts is not associated with cholelithiasis, and conversely in large groups of cases of common duct lithiasis, an associated duct carcinoma is a rare finding, quite unlike the usual association of stones with carcinoma of the gall-bladder.

However, one of the older views regarding the etiology of pancreatic cancer was that chronic irritation such as chronic pancreatitis was the precursor of the malignancy. Against this view is the fact that in the twelve cases of carcinoma of the pancreas coming to necropsy, only two showed histologic evidence of a chronic interstitial pancreatitis, the remainder of the pancreases showing no important abnormality other than the cancer.

Another point of interest was the fact that in twelve of the jaundiced cases, the gall-bladder contained "white bile" and in seven others, pale bile. Under such circumstances, excluding, of course, cases of hydrops due to stone in the cystic duct, the entire duct system usually contains the same type of material and denotes a marked depression of the liver function.

In these cases, it has been our custom, when possible, to perform an anastomosis between the gall-bladder and the gastro-

intestinal tract, in the hopes that the release of back pressure and the free internal drainage of the biliary system will allow the liver to recover and regain its function. Occasionally this occurred and definite clinical improvement resulted from the operation. On the other hand, due to the impaired hepatic function, the danger of operation in these cases is great, as is indicated by the operative mortality of over 50 per cent for this particular group. The general impression that the presence of white bile in the gall-bladder and bile ducts in the presence of obstructive jaundice is of grave import was well borne out in the present study.

TABLE XVI  
CHARACTER OF GALL-BLADDER CONTENTS AT TIME  
OF OPERATION (89 CASES)

Contents of Gall-bladder	No. of Cases	Per Cent
Patients with Jaundice (72 Cases)		
1. Thick concentrated bile.....	29	40.29
2. Normal bile.....	12	16.67
3. Pale bile.....	7	9.72
4. White bile.....	7	9.72
5. White bile and stones.....	5	6.94
6. Stones.....	5	6.94
7. Gall-bladder not opened.....	4	5.55
8. Normal bile with solitary stone....	2	2.78
9. Empyema of gall-bladder with stone.....	1	1.39
Total.....	72	100.0
Patients without Jaundice (17 Cases)		
1. Gall-bladder not opened.....	9	52.94
2. Normal bile.....	6	35.30
3. Stones.....	2	11.76
Total.....	17	100.0

Table xvii lists the various operations which were performed. Cholecystogastrotomy was the type of anastomosis which was most often feasible. While cholecystoduodenostomy was performed in seven cases without a death, it was employed only when an unusually mobile duodenum allowed the anastomosis to be performed

without tension. Rienhoff and Lewis state that this type of operation should never be employed in carcinoma of the pancreas inasmuch as the duodenum is frequently involved or bound down by the growth. While theoretically the duodenum would be preferable to the stomach for the anastomosis, the functional results of the two operations were identical as far as could be determined. Lahey<sup>29</sup> has recently advocated cholecystojejunostomy in preference to either cholecystogastrostomy or cholecystoduodenostomy. With this operation we have had no experience.

TABLE XVII  
OPERATIONS PERFORMED AND OPERATIVE MORTALITY

Operation	No. of Cases	Per Cent	No. of Deaths	Per Cent Mortality
1. Cholecystogastrostomy . . .	48	53.04	14	29.17
2. Exploratory laparotomy . . .	11	14.61	4	36.37
3. Cholecystoduodenostomy . . .	7	7.85	0	0
4. Cholecystostomy . . .	4	4.40	1	25.0
5. Cholecystostomy and choledochostomy . . .	2	2.25	1	50.0
6. Cholecystostomy and posterior gastroenterostomy . . .	2	2.25	1	50.0
7. Posterior gastroenterostomy . . .	2	2.25	1	50.0
8. Transduodenal resection of ampulla . . .	2	2.25	0	0
9. Multiple operations . . .	2	2.25	0	0
10. Cholecystoduodenostomy and posterior gastroenterostomy . . .	1	1.12	0	0
11. Cholecystoduodenostomy and exploratory choledochostomy . . .	1	1.12	0	0
12. Cholecystogastrostomy and posterior gastroenterostomy . . .	1	1.12	0	0
13. Cholecystogastrostomy and choledochostomy . . .	1	1.12	0	0
14. Choledochostomy . . .	1	1.12	0	0
15. Transduodenal resection of ampulla and cholecystectomy . . .	1	1.12	1	100.0
16. Cholecystectomy and choledochostomy . . .	1	1.12	1	100.0
Total . . .	80	100.	24	29.97

One of the patients who had multiple operations in the hospital had first a cholecystogastrostomy with subsequent disappearance of the jaundice. At a later date he developed symptoms of pyloric obstruction, necessitating a posterior gastroenterostomy. The second of these patients requiring multiple operations had had a cholecystoduodenostomy performed in another hospital for what was thought

to be chronic indurative pancreatitis. He was admitted with recurrence of jaundice. Contraction of the stoma had occurred and accordingly the anastomosis was reestablished. He likewise subsequently developed pyloric obstruction and the next operation consisted of a posterior gastroenterostomy.

Aside from the three cases of resection of the lower end of the common duct for carcinoma of the ampulla of Vater, no radical resections were attempted. The majority of the patients had far advanced lesions and palliative procedures were the only ones which seemed justifiable. Table XVII also gives the hospital mortality for the various procedures. Obviously these mortality figures are of little importance in the selection of an operative procedure as many of the situations were desperate, and certain operations such as cholecystostomy or choledochostomy were frequently the only means of palliation possible. The total hospital mortality was 26.97 per cent.

In 1934, Collier and Winfield<sup>30</sup> reviewed the end-results of biliary intestinal anastomosis as a palliative operation in twenty-one patients of this group, following their discharge from the hospital. The average duration of life was 7.2 months. In 78 per cent there was relief of pain, in 100 per cent relief of pruritus and partial or complete relief of jaundice in 95 per cent. Long periods of survival with complete relief of symptoms are occasionally reported. Two such cases have occurred in our experience. In such cases one is driven to the conclusion that the mass felt in the pancreas at the time of operation was in fact inflammatory rather than neoplastic, and that the internal drainage of the biliary tract resulted in a permanent cure. Unfortunately, the operative diagnosis of malignant disease is usually correct. Another argument in favor of exploration is the possibility that a common duct stone may be found. In such cases surgical removal can effect a cure and because of the possibility of a mistaken diagnosis, operation should not be withheld.

Of the eighty-nine cases operated upon, biopsy material was taken at the time of the laparotomy in thirty-six, and in the three cases of resection for cancer of the ampulla, the entire lesion was removed. A microscopic diagnosis of cancer was made in the three latter cases. Of the thirty-six biopsy specimens, thirteen were taken from the gall-bladder, and as previously mentioned, eleven showed chronic cholecystitis and two invasion of the gall-bladder wall by carcinoma.

Biopsy of nodules in the liver was performed eight times and in each case the microscopic examination confirmed the operator's opinion of metastatic carcinoma. In three cases, nodules were removed from the omentum and all three showed carcinoma microscopically. In nine cases of advanced lesions of the common duct, a bit of tissue for biopsy was taken with the electrosurgical loop. The diagnosis of carcinoma was confirmed in all these instances by the pathologist. Lymph node biopsies were performed in six patients, a regional node being removed; in two of these, metastatic carcinoma was found and in the remaining four a chronic lymphadenitis only. A biopsy specimen from a pancreatic lesion was taken four times. In three a diagnosis of carcinoma was reported and in one the examination was negative. Even with the electrosurgical loop, biopsy of the pancreas is decidedly hazardous, as troublesome bleeding may occur, which may be exceedingly difficult to control and may result in unnecessary prolongation of the operation. Furthermore, leakage of pancreatic secretions from one of the lesser pancreatic ducts may take place with disastrous results.

Table xviii shows in a comparative way the operative and the necropsy diagnosis in ten cases coming to post-mortem examination following surgery. The one patient with common duct stones had in addition a carcinoma of the lower end of the common duct which was not discovered until necropsy. Disregarding this one case, it will be noted that whereas the operator

made a diagnosis of pancreatic cancer in six cases and carcinoma of the bile ducts in three, this ratio was reversed when the necropsy findings were available. In other words, it seems quite impossible to distinguish either clinically or at the operating table between cancer of the common duct

TABLE XVIII  
COMPARISON OF OPERATIVE AND NECROPSY DIAGNOSES  
IN 10 POST-OPERATIVE DEATHS

Operative Diagnoses		Necropsy Diagnoses	
1. Carcinoma of the pancreas.....	6	Carcinoma of the pancreas.....	3
2. Carcinoma of bile ducts.....	3	Carcinoma of bile ducts.....	7
3. Common duct stones	1		
Total.....	10	Total.....	10

and of the head of the pancreas in many cases, and undoubtedly many cases recorded as pancreatic carcinoma were in reality examples of carcinoma of the bile ducts. Both lesions should therefore be included in any clinical discussion.

TABLE XIX  
CAUSE OF DEATH IN 24 POST-OPERATIVE HOSPITAL DEATHS

Cause	No. of Cases	Autopsy	No Autopsy
1. Post-operative hemorrhage....	8	5	3
2. Pneumonia.....	6	3	3
3. Cholemia.....	6	0	6
4. Leakage at site of anastomosis bile peritonitis.....	1	1	0
5. Shock.....	2	0	2
6. Cancer cachexia (death 4 months P.O.).....	1	1	0
Total.....	24	10	14

Table xix gives the cause of death in the twenty-four patients dying following surgical operation. Post-operative hemorrhage was responsible for death in one-third of the cases. A second common cause of death was pneumonia, not a surprising finding considering the fact that most of the patients were debilitated, cachectic and aged, poor surgical risks, especially for operations in the upper quadrants of the abdomen. Cholemia or hepatic insufficiency

was likewise responsible for the fatal outcome in one-quarter of the cases, death usually occurring in about 10 to 14 days following operation. One death was due to bile peritonitis from a leaking suture line, while one patient remained in the hospital for four months after operation and ultimately succumbed to the disease.

#### NECROPSY FINDINGS

As noted in Table I, post-mortem examinations were conducted in thirty cases, ten of these being post-operative fatalities and the remaining twenty cases in which no operative treatment had been undertaken. During this same twelve year period a total number of 4,657 necropsies was performed. Thus in the necropsy material of the hospital there was an incidence of one case of carcinoma of the pancreas or bile ducts per 155 necropsies.

TABLE XX  
LOCATION OF PRIMARY LESION IN 30 NECROPSIES

Primary	No. of Cases	Per Cent
1. Pancreas.....	12	40.00
2. Common duct.....	8	26.68
3. Ampulla of Vater.....	5	16.66
4. Cystic duct.....	3	10.00
5. Hepatic duct.....	2	6.66
Total.....	30	100.00

Table xx shows the location of the primary lesion in these thirty cases as it was determined by the histologic examination of the necropsy material. While this group of cases is admittedly small, it is of considerable interest to note that primary carcinoma of the extrahepatic bile ducts occurred one and one-half times as frequently as primary carcinoma of the pancreas. As mentioned above, it is probably true that many cases in which a clinical or even an operative diagnosis of carcinoma of the head of the pancreas is made, are in reality cases of primary carcinoma of the bile ducts. While such a distinction is often of academic interest

only, it nevertheless indicates the possibility of complete extirpation of the lesion if a timely operation is performed. Assuming that the incidence of carcinoma of the lower common duct or ampulla is somewhat greater than has been generally realized, it is probable that in the future more cases will be found suitable for radical surgery than has been the case heretofore. With the two-stage procedure of Whipple, Parsons and Mullins, the hazard of operation is considerably reduced, while a sufficiently wide margin of tissue is resected to make permanent cure possible.

According to the post-mortem findings, five of the duct carcinomas were quite localized, without distant metastases, and complete eradication of the lesion would have been possible. The same was true of only two of the pancreatic cancers, one of which was situated in the head of the organ and the other in the body.

Table XXI indicates the location of metastatic lesions in the nineteen cases

TABLE XXI  
METASTASES AS FOUND AT NECROPSY IN 19 CASES

Metastases	No. of Cases
1. Regional lymph nodes.....	3
2. Liver and lungs.....	2
3. Liver and retroperitoneal lymph nodes.....	2
4. Liver.....	1
5. Bone marrow.....	1
6. Liver—regional lymph nodes and lungs.....	1
7. Mesenteric lymph nodes.....	1
8. Liver—lungs. Peripancreatic lymph nodes, retroperitoneal lymph nodes, bronchial nodes and thyroid.....	1
9. Liver, adrenal, retroperitoneal lymph nodes, sternum, thoracic and lumbar vertebrae, and right pectoral muscle.....	1
10. Liver—portal and peripancreatic lymph nodes, tail of pancreas, capsule of spleen, lungs and bronchial lymph nodes.....	1
11. Liver, peritoneal surfaces, omentum, mesentery and regional lymph nodes.....	1
12. Left thoracic wall, ribs, sternum, vertebrae, retroperitoneal nodes, liver, spleen, adrenal, lung, mediastinal and axillary lymph nodes....	1
13. Duodenum, peripancreatic lymph nodes, pericholecystic tissues, liver and gall-bladder....	1
14. Regional, mesenteric, mediastinal and peribronchial nodes, under-surface of diaphragm, liver, gall-bladder, lungs, pleura, sternum and sixth right rib.....	1
15. Regional lymph nodes, lungs, bronchial and mediastinal nodes, diaphragm, small intestine and appendix.....	1

in which metastases were found. The regional lymph nodes were involved in fifteen cases, while hepatic metastases occurred in thirteen and pulmonary metastases in eight.

TABLE XXII

DIRECT EXTENSION OF NEOPLASM AS FOUND AT NECROPSY  
IN 15 CASES

Primary Carcinoma of Bile Ducts	
Extension	No. of Cases
1. Head of pancreas.....	3
2. Duodenum.....	2
3. Liver.....	1
4. Pancreas and omentum.....	1
5. Gall-bladder and liver.....	1
6. Head of pancreas and duodenum.....	1
7. Hepatogastric ligament and liver.....	1
Primary Carcinoma of Pancreas	
Extension	No. of Cases
1. Duodenum.....	2
2. Common duct.....	1
3. Peripancreatic and retroperitoneal tissues, left adrenal, kidney and ureter.....	1
4. Liver, gall-bladder, duodenum, small intestine and colon.....	1

Table xxii shows the various regions involved by direct extension of the neoplastic process. In the case of primary carcinoma of the bile ducts, the pancreas was often infiltrated, thus accounting for the ease and frequency with which a diagnosis of primary carcinoma of the pancreas was made at the operating table.

In four cases in the necropsy group multiple malignancies were present, there being a second independent primary carcinoma in addition to that found in the pancreas or bile ducts (Table xxiii).

TABLE XXIII

CASES OF MULTIPLE MALIGNANCIES IN 30 NECROPSIES

1. C. R. Path No. A-43—A. K.—male 63.
  - (a) Undifferentiated medullary adenocarcinoma of pancreas.
  - (b) Recurrent medullary squamous cell carcinoma of the lip.
2. J. P. Path No. A-260—A. L.—female 48.
  - (a) Medullary adenocarcinoma of pancreas.
  - (b) Early carcinoma arising in right multilocular parovarian cystadenoma.
3. P. L. Path No. A-220—A. J.—male 63.
  - (a) Advanced adenocarcinoma of common duct at ampulla of Vater.
  - (b) Early medullary carcinoma of prostate.
4. H. R. Path No. A-64—A. M.—male 54.
  - (a) Gland cell carcinoma of head of pancreas.
  - (b) Primary medullary squamous cell carcinoma of upper and middle lobes of right lung.

While various factors such as alcohol, syphilis and chronic inflammation have

been suggested as etiologic agents in pancreatic cancer, there is little positive evidence to support these views. In this necropsy group of thirty cases, there was histologic evidence of syphilis in only six and these were all cases of cancer of the bile ducts rather than of the pancreas.

## SUMMARY

1. A group of 109 cases of carcinoma of the pancreas and extrahepatic bile ducts, verified by operation or necropsy, has been reviewed.

2. The disease occurred approximately twice as frequently in males as in females.

3. The average age of the patients was 56.9 years.

4. Weight loss was the most common symptom. It was usually extreme (average 13.8 kg.) and occurred rapidly.

5. Jaundice was the most common chief complaint and abdominal pain the most common initial symptom.

6. The average duration of symptoms was 5.5 months.

7. Jaundice was the most common physical sign and was present in over three-fourths of the cases.

8. Courvoisier's law was of relatively little value in making a correct diagnosis prior to operation. The law was of considerable value to the surgeon at the time of laparotomy, as it indicated the type of duct obstruction which was present. The operative findings proved the law to be accurate in over 80 per cent of the cases.

9. Laboratory studies were of practically no value in diagnosis.

10. Roentgen studies were positive or suggestive in one-fourth of the cases.

11. In the non-icteric patients the difficulties in diagnosis were greater than in the icteric group. In the former cases the condition was most often confused with carcinoma of the stomach or colon.

12. Evidence of antecedent biliary tract infection, as indicated by contraction of the gall-bladder or thickening of its wall, was noted in approximately one-eighth of the operative cases, while calculi were present in the gall-bladder in one-sixth.

13. Cholecystogastrostomy was regarded as the best palliative operation. The operative mortality for this procedure was 29.17 per cent.

14. In ten cases, according to the diagnoses made at the time of operation, the ratio of cases of carcinoma of the pancreas and of the bile ducts was 2:1. Necropsy examination of these same cases proved that the ratio was 1:2.

15. In three cases of carcinoma of the ampulla of Vater, transduodenal resection was performed, with one post-operative death and two recoveries.

16. Hemorrhage was the most common cause of death following operation.

17. The average duration of life following palliative biliary gastrointestinal anastomosis was 7.2 months in a group of twenty-one patients traced.

18. Post-mortem examination showed the most common site of metastases to be the regional lymphnodes, while metastases to the liver and lungs occurred next in frequency.

19. In the group of thirty cases examined post-mortem, there were four instances of multiple malignancies.

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# THE COMPLICATIONS OF GALL-BLADDER AND STOMACH SURGERY

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TO be complete, a discussion of the complications that may follow either gall-bladder or gastric surgery would include for consideration all the possibilities for trouble following any laparotomy. In this paper, however, we shall write only of our experiences with the most common lesions that we have noted following biliary or gastric operations and omit any discussion of complications not specifically related to surgery in these areas.

Certain complications may be said to be common to surgery on either the stomach or the gall-bladder and may well be first considered in this discussion.

*Fever.* Fever which persists more than a few days must always be accounted for, and it is best to have a systematic scheme to follow in the search for its cause. Usually fever following stomach or gall-bladder surgery is due to infection in the wound and, therefore, in the presence of fever, the wound must be repeatedly inspected. Small areas of induration which are tender will occasionally be found. These we are inclined to poultice for a day or two and then gently probe. At times, one of the deep sutures will have to be removed because of infection about it. The earlier this is done the better. We cannot emphasize too strongly the necessity of repeatedly examining the wound in unexplained post-operative fever. In a recent case of subtotal gastrectomy for cancer, fever due to a deep wound abscess appeared some four days post-operatively and yet a wound abscess was only found seven days later after repeated daily investigation.

If one is satisfied by inspection, palpation, and probing that no infection is

present in the wound, the pouch of Douglas should be examined. Repeated rectal examinations may demonstrate a boggy, tender collection of pus in this area. Often rectal tenesmus is present if the collection of fluid is large. One must delay in incising abscesses in Douglas' pouch until fluctuation is present and then they may be opened through the rectum in the male or the vagina in the female.

Second to collections of pus in the wound after gall-bladder or stomach surgery, however, comes an infection in the subphrenic area as a cause of post-operative fever. Subphrenic abscess is very frequently unrecognized because it is not suspected. Unfortunately, subphrenic abscess gives little in the way of symptoms, save unexplained fever. It must be thought of as a possibility if it is to be diagnosed and x-rays must be taken to prove or disprove its presence.

Most subphrenic abscesses appear on the right side—as for instance, after cholecystectomy, suture of a perforated ulcer, or pyloroplasty. Twice, however, we have seen left-sided subphrenic abscess formation following very high gastric resections. Knowledge of the etiologic factors producing subphrenic abscess is therefore helpful not only in suspecting its presence but also in determining its location.

Subphrenic abscess should be suspected: (1) when post-operative x-rays show a high fixed diaphragm with an obliterated or narrowed costophrenic angle; (2) when the x-ray shows either pleural fluid or consolidation of the lung by pressure of the elevated diaphragm on the affected side; (3) when there is an air bubble beneath the

diaphragm and above the liver; and (4) when the patient has an unexplained fever following upper abdominal surgery.

We shall not discuss the treatment of subphrenic abscess more than to say that in about thirty cases we have found the two-stage transpleural approach a very satisfactory method for drainage.

*Respiratory Complications.* *Pleurisy* with effusion, *pneumonia*, and *atelectasis* are by no means uncommon post-operative complications of upper abdominal surgery. The presence of any of these disorders may be detected not only by physical signs, but also by the chest plate taken to learn about the possibility of a subphrenic abscess. We shall not discuss in this paper the management of these difficulties.

*Wound Rupture.* Wound rupture may follow surgery on either the gall-bladder or the stomach, especially if the surgery has been for a seriously infected lesion or for malignancy. It is our belief that wound rupture occurs many more times than does its recognition, and that a great majority of post-operative ventral hernias start in the first few days after operation when the transversalis muscle and fascia sutures are disrupted. If one inquires, patients very commonly can recall feeling something break in the wound during a severe vomiting or coughing spell.

Post-operative wound rupture may be partial or complete. In partial rupture, one very often finds that there is a sudden leakage from the wound of a large amount of serosanguineous fluid. There frequently is such a profuse drainage of serum that it wets the dressings, swathe and bedclothes. Casual inspection of the wound in such a case may show a small bit of omentum protruding between the sutures, in which case the diagnosis is simple. In many cases, on the other hand, the wound will appear quite normal. With such a history, however, the wound should be thoroughly painted with iodine and a probe inserted between the sutures. When the deep layers are ruptured, the probe will pass freely into the peritoneal cavity. In complete rupture,

which fortunately is more rare, the skin sutures, as well as the deep stitches, are broken and omentum or intestines are freely protruding.

It has been our practice, when the patient's condition warrants, to suture ruptured wounds at once, under either local or spinal anesthesia. We have found multiple double silkworm gut sutures, passed through all layers of the abdominal wall and closely spaced, very satisfactory. In some cases, the patient's condition will be so critical that one does not dare suture the wound. Here, adhesive strapping over sterile gauze may be used, but it has proved a very unsatisfactory makeshift in our hands.

We believe that partial rupture of upper abdominal wounds is frequently the cause of post-operative vomiting by the angulation and constriction of a loop of small gut at the point of wound rupture. Searching these post-operative wounds for rupture occasionally explains persistent post-operative vomiting, and should be routinely performed in cases of troublesome vomiting after laparotomies.

*Fluid Balance.* Operations on the gall-bladder or stomach are perhaps more likely to be followed by significant changes in the patient's fluid balance than are other abdominal operations. Not only are these patients frequently unable to take fluids by mouth, but they also may lose fluids excessively from vomiting, fistulae, or gastric lavage. It is most important that these fluids lost be returned to the patient both quantitatively and qualitatively.

Maintenance of proper electrolyte and fluid balance post-operatively, using the methods so well worked out by Coller, Maddock and their associates<sup>3,4,5,6,9,10,12</sup> will, in large measure, prevent or correct such complications as dehydration, hypochloremia, sodium chloride retention with edema, and embarrassment of the circulation from overloading. The clinical signs of dehydration, namely: dry hot skin, tongue, and mucous membranes; sunken eyes; fever; plus the laboratory findings of less



than 500 c.c. total twenty-four-hour urinary output, with concentration up to 1.040 (specific gravity) and blood non-protein nitrogen of 40 mg. per cent and above, are recognizable early.

The daily water loss of the surgical patient has been found by Collier and Maddock to be approximately:

	Cc.
Vaporization through skin and lungs. . . .	2000
Water for urine. . . . .	1500
Abnormal water loss:	
Vomitus	
Diarrhea	
Drainage:	
Biliary	
Duodenal	
Pancreatic	
Enterostomy	
Total twenty-four-hour loss. . . . .	3500 to 6000

In addition, Collier has shown that the average loss of water during operation and for the next four hours is 1000 c.c. This should be additionally replaced in the first twenty-four hours.

With a urinary output of less than 500 c.c. in twenty-four hours, retention of waste materials can be looked for, and the blood non-protein nitrogen will generally be found elevated. The normal kidney should have available for excretion 1500 c.c. of water daily to get rid of the usual amount of waste products with a minimum of effort.

Collier and Maddock (personal communication) have shown that by replacing parenterally the total lost fluids with the same volume of either normal saline or Ringer's solution in a single massive dose, the chloride and sodium electrolyte levels in the blood stream will be adequately restored. The additional fluid requirements are then supplied with 5 or 10 per cent glucose in sterile water intravenously, at the safe rate of 500 c.c. per hour, supplementing oral, rectal and subcutaneous fluids. Thus both ketosis and excess administration of sodium chloride are avoided.

Total protein depletion may be detected by lowered serum protein determination,

and may be corrected by blood transfusion and increased protein in the diet.

*Hiccup.* The development of hiccup in the post-operative patient means irritation of the diaphragm or of a reflex arc involving the phrenic nerves, and search should be made for the cause. Mayo<sup>11</sup> has classified hiccup etiologically as:

- A. Infectious persistent hiccup (usually central in origin)
  - (1) Epidemic type
  - (2) Post-operative type
- B. Chemical hiccup
  - (1) Central origin (of questionable existence)
  - (2) Peripheral (reflex from chemical irritation of stomach, intestine, diaphragm or of some structure of the same somatic segment as the diaphragm)
  - (3) Mechanical (Reflex from pressure)
    - (a) Central origin
      - Tumor
      - Vascular disturbance
    - (b) Peripheral origin
      - Stomach (rapid dilatation or slow dilatation of long duration)
      - Tumor (irritation of diaphragm and phrenic nerve)
      - Vascular disturbance
    - (c) Hysterical or psychic
    - (d) Indeterminate

Dr. Mayo has noted the affection only in men, usually over 45 years of age, chiefly following major operations on the colon, stomach, or urinary tract. Onset occurs between the first and seventh post-operative days, and the condition usually lasts from four to twenty-seven days, with an average of seven to nine days. It is more frequent during the winter months.

In treatment, attention must be directed toward the elimination of the chemical and mechanical irritative complications especially. Distention should be combated by the early prophylactic administration of morphine adequate to maintain the muscu-

lar tone of the intestinal tract, thus preventing overdistention of bowel segments. Decompression of the stomach and small

Then cervical infiltration of the phrenic nerve with 2 per cent novocaine on one or both sides may be tried, with the patient

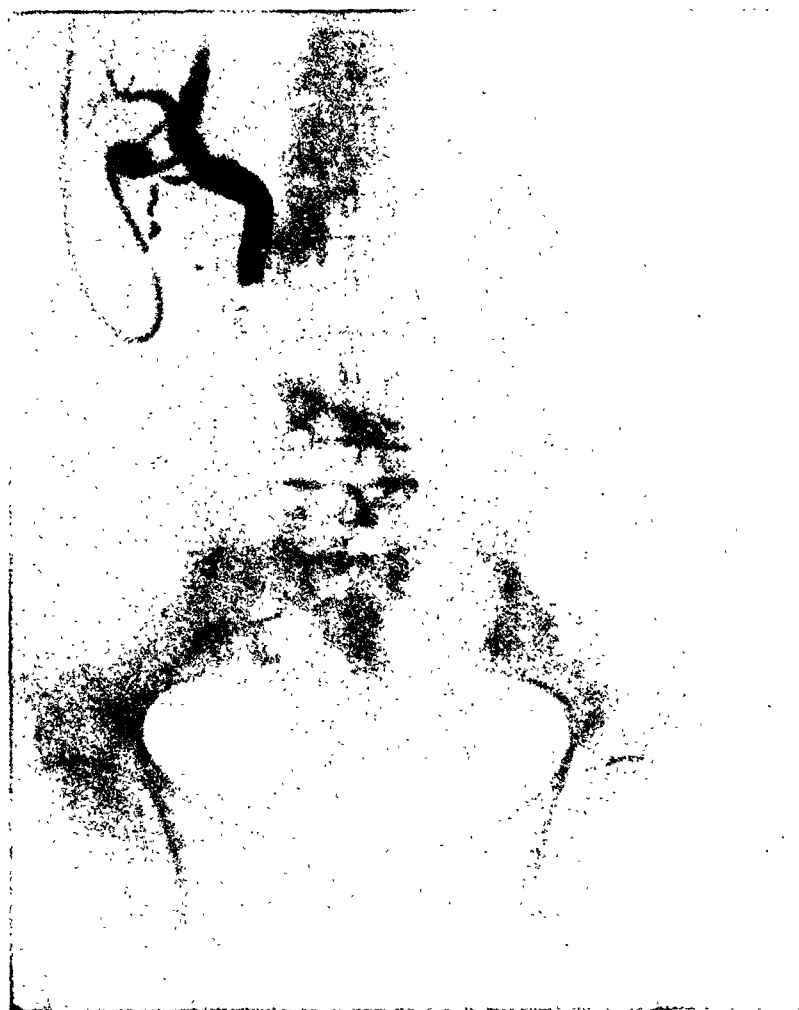


FIG. 1. Gallstones and common duct stones twelve days after cholecystectomy, choledochostomy and dilatation of sphincter of Oddi. T-tube injected with lipiodol gave pain. X-ray showed obstruction at ampulla of Vater.

bowel by gastric lavage with sodium bicarbonate solution and by suction drainage may prove helpful. Increased use of narcotics and sedatives, plus repeated carbon dioxide and oxygen inhalations for not more than fifteen minutes at a time, will in the majority of cases prove ultimately effective.

When the hiccup persists with exhausting effect for more than seven days, we must consider more radical measures, directed toward temporary interruption of the phrenic nerve pathways. The patient may be fluoroscoped to determine on which side the diaphragm is the more convulsive.

under the fluoroscope, and the effect on the excursions of the diaphragm noted.

In one patient, Dr. C. B., a 63 year old physician who hiccupped alarmingly for thirteen days after surgery of the large bowel, the effect of bilateral novocaine injection lasted for only twenty minutes. Consequently, both phrenic nerves were crushed but not avulsed. The hiccups stopped and the patient recovered satisfactorily. However, he suffered from fairly marked respiratory embarrassment for a time due to the heaving, abdominocostal type of breathing. Later the diaphragm gradually regained its

activity by setting up its own neuro-muscular reflex mechanism, and the patient rapidly improved. Six months later better. Accordingly, knowledge of the symptoms and signs of this accident is most important.



FIG. 2. Following administration of nitroglycerin some relief of pain. X-ray showed slight relaxation of sphincter of Oddi.

(April 1937), he still had some conscious respiratory effort and dyspnea on exertion, but was steadily improving, and he had returned to active practice.

**Common Duct Injury.** Surgery of the biliary tract has many possible complications, only a few of which can be discussed at this time. Perhaps the major trouble, from the point of view of ultimate serious damage, is an injury to the common bile duct during cholecystectomy. This will seldom if ever occur, if adequate exposure of the cystic, common, and hepatic ducts is obtained before the cystic duct is clamped. Once the common duct has been injured, however, the earlier it is repaired the

Most injuries of the common duct during cholecystectomy arise because (a) the duct is clamped during an attempt to control a bleeding cystic artery, or (b) because the common duct is pulled up with the cystic duct and is tied or cut off. The result, in each case, is that the common duct is either partly or completely obstructed and the patient becomes jaundiced.

Obstructive jaundice appearing within a few days of cholecystectomy, especially if not accompanied by pain, usually means injury to the common or hepatic ducts and, in our opinion, demands an immediate secondary operation to correct it. In a

recent case, cholecystectomy had been performed elsewhere seven days before and jaundice had appeared three days

Many surgeons now use some type of dilating probe routinely after opening the common duct. It is to be recalled that these



FIG. 3. On the twenty-first day 5 c.c. of ether were injected, 1 c.c. at a time, into the T-tube. Much pain followed. Relieved with nitroglycerin. Lipiodol injection shows sphincter patent and dye passing through.

later and grown steadily worse. The urine contained bile and the stools were gray in color. An immediate secondary operation revealed the cystic duct tie occluding most of the lumen of the common duct. We were able to remove the tie and insert a T-tube into the common duct with a successful outcome. If the common duct has been cut off, we believe the best procedure to be an anastomosis of the proximal end into the duodenum. End-to-end suture of the common duct has been successful occasionally, but in our experience, it is very often followed by stricture formation at the point of suture.

dilators are used only to enlarge the papilla of Vater and stretch the sphincter of Oddi. We speak loosely of "dilating the common duct," which is precisely what we must not do. Stretching the common duct may injure its walls and lead to stricture formation. The probes and dilators used must be smaller than the lumen of the common duct, and must never be forced through by heavy pressure.

A dangerous complication of common duct drainage is leakage about the point of entrance of the T-tube into the common duct and the production of a bile (chemical) peritonitis. In rare cases, the common

duct tube may be pulled out accidentally in our experience, the T-tube was apparently partly pulled out of the duct and bent so that it obstructed the lumen. before firm adhesions have formed to establish a sinus tract to the skin. Bile



FIG. 4. Picture thirty minutes after Figure 3. Common duct empty. Dye in intestine. T-tube removed three days later and patient has had no further trouble.

peritonitis with distention, ileus, nausea, vomiting, and death may follow. If one were certain that this accident had occurred and the patient's condition permitted, immediate operation to reinsert the drain into the common duct would be indicated.

Various special complications may occur in connection with the use of a T-tube in the common duct. One of the most disturbing is the occurrence of jaundice and pain when the tube is clamped off. With x-rays taken after lipiodol injection into the tube, one may decide whether the common duct is obstructed by a stone or by spasm of the sphincter of Oddi. Twice

Nice judgment is required in these cases to decide whether or not to pull out the tube. When one is certain that an overlooked stone remains in the common duct, attempts to relax the sphincter of Oddi by nitroglycerin may be used. If these fail, a secondary operation will eventually be necessary in most cases. In a recent case, however, we followed the technique described by Pribram<sup>13</sup> and recently demonstrated by Walters,<sup>14</sup> of injecting ether into the T-tube and dissolving (?) the common duct stone. The accompanying x-rays describe our procedure and results. We are not at all sure that this technique is free from danger and we are certain

that it should be used with great care. (Figs. 1, 2, 3 and 4.) It is apparent to us that, whenever possible, lipiodol injections and x-ray pictures should be made of the common duct before the T-tube is removed.

**Hemorrhage.** Post-operative hemorrhage in the non-jaundiced gall-bladder patient usually means bleeding from an uncontrolled cystic artery stump or from damaged liver tissue underlying the gall-bladder bed. Injury to the hepatic artery or portal vein should be rare to nonexistent. Occasionally, however, one encounters a rich plexus of small veins overlying the common duct, and these may prove a troublesome source of oozing during and after common duct surgery. Low blood pressure during spinal anesthesia may mask bleeding points, and this should be considered before closing the abdomen.

Separate visualization and ligation of the cystic artery before proceeding with removal of the gall-bladder is strongly recommended. If active, serious hemorrhage later develops, then the patient should be transfused, re-operated early and the cystic artery controlled. This accident must be extremely rare for few cases are reported.

Slow oozing of dark blood from deep in the wound may well indicate the presence of a deep retroperitoneal hematoma if wound rupture is carefully excluded. This deep hematoma becomes especially serious in its effect if secondary infection from the gall-bladder bed occurs. The treatment should be supportive, with the use of fluids, glucose, and transfusion, plus careful loosening of the drain somewhat earlier than usual. These patients, in our experience, do not tolerate secondary operation well. They will generally recover unless severe secondary infection is a complication.

Hemorrhage following biliary tract surgery on the jaundiced patient is unfortunately still common in spite of the great amount of advance that has been made in preparing these patients for operation. There is no liver function test or blood test that will faithfully predict the hemorrhagic diathesis in jaundiced patients. Probably

the Ivy test for bleeding time is most helpful, but it is not infallible.

Treatment for hemorrhage after operation on jaundiced cases should be undertaken at the earliest sign of bleeding. If the drainage from the bile tract is pink-stained, or if the wound weeps a little blood between sutures, no time should be lost in starting treatment.

The best treatment is, of course, the prevention of bleeding by long pre-operative preparation of the patient with glucose, viosterol and transfusions, so that the liver function is as largely improved as may be. Should the bleeding occur after operation, we rely upon blood transfusions, repeated as often as is necessary. Providing the jaundice may be expected to improve as a result of the surgery, there is almost no limit to the number of transfusions that should be given to control post-operative bleeding. In addition to transfusions, we also use large amounts of glucose in distilled water in these cases.

Hemorrhage in the post-operative stomach patient most commonly means bleeding from the suture line or from an ulcer that has not been removed. Much more rarely does it arise from an esophageal or intestinal varix or from one of the blood dyscrasias. Experience has shown that the treatment in most cases should be supportive and expectant rather than reoperation, which carries a prohibitively severe risk. Some of these patients have been reoperated, the stomach opened and no bleeding point established. It is a severely shocking procedure that the depleted patient cannot stand. Better results have been obtained in our hands by repeated small transfusions, morphine, parenteral fluids and glucose, and nothing by mouth.

**"Liver Failure."** So-called "liver failure" after biliary tract surgery is believed to occur and no doubt does. One cannot but suspect, however, that deaths from peritonitis, pneumonia, obstruction, and even hemorrhage are occasionally erroneously described under this blanket term of "liver failure" when no postmortem

check-up is available. The condition is to many a vague and yet comprehensive state of serious depletion of all the vital forces which occurs at times after biliary surgery and which cannot be explained. This so-called "liver failure" is most likely to occur in the poorest risks for biliary surgery, who harbor serious lesions in their heart, blood vessels or kidneys. Such cases must be recognized before biliary tract surgery is undertaken, and special measures taken to prepare them for operation.

When liver failure does occur after operation, it must be treated by the use of much glucose and by blood transfusions just as in the jaundiced patient with post-operative bleeding.

*Vomiting.* Vomiting is perhaps the most frequent and often the most trying complication after gastric surgery. It is generally due to edema at the point where the stomach is united to the intestine. Because of this edema, either rapid or slow dilatation of the stomach occurs, and alkalosis and its attendant difficulties may rapidly ensue.

Active measures must therefore be undertaken to prevent such collections of fluid from remaining in the stomach after gastric surgery. On the evening of the day of operation, we pass a nasal tube and gently aspirate the stomach residue. If we obtain 100 c.c. or more of fluid, it is our practice in the majority of cases to leave the nasal tube in place for one or two days to prevent gastric distention, tension on the suture line, and the excess accumulation of secretions. The tube may be periodically clamped to lessen the fluid and chloride loss. Water is given by mouth while the tube is draining. If distention and gastric drainage increase, then Wangenstein suction may be applied, with due attention to the maintenance of fluid balance. If little or no fluid is obtained, we remove the tube but pass it twice each day routinely for four days to be sure gastric dilatation is not present.

After some gastric operations, retention persists for one to even three weeks and

becomes a most disturbing complication. In the past, we have operated again on these patients and attempted to find an organic obstruction that we might relieve. These attempts have been almost invariably failures. We now continue the nasal tube drainage and find that almost always the end result is a patent stoma that is no longer obstructed. If the patient's condition fails from loss of proteins, we have several times done a jejunostomy in the left upper quadrant under local anesthesia. With this jejunostomy, a continuous Murphy drip is set up and peptonized milk, sugar, tomato juice, etc., are given. By this means we have several times had final successful results when the outlook had appeared to be quite hopeless.

*Peritonitis.* In addition to post-operative vomiting, the two commonest complications to be feared after stomach surgery are peritonitis and hemorrhage. Their prevention depends to a large extent on the security of the anastomotic suture line. The commonest causes of peritonitis post-operatively are soiling of the operative field and leakage at the suture line of either the closed duodenal stump or that of the gastroenteric anastomosis. Utmost care must be taken with layered closure of the duodenal stump.<sup>1</sup> With the use of three inverting layers of silk rather than catgut, the results have been very satisfactory. The question of inserting a drain down to the closed duodenal stump repeatedly comes up. It is our practice not to drain unless there has been soiling of the area or unless a not wholly satisfactory closure of the stump has been made.<sup>2</sup>

*Abscess.* In the occasional case, a localized intra-abdominal abscess at one of the suture lines will manifest itself by persistent fever, usually with signs of partial obstruction, without the rising pulse and severe toxemia of general peritonitis. This may be the result of soiling or of a very tiny leak. Illustration of this was found in one of our patients, a 63 year old male, who on his fifth post-operative day developed persistent fever and signs of high

obstruction following subtotal gastrectomy for cancer of the stomach. On the ninth day, the abdomen was reopened and a well localized, foul smelling abscess in the region of the closed duodenal stump was evacuated and drained. No leak in the suture line could be found. An enterostomy for feeding was made, and this was followed by rapid complete recovery.

Treatment of these disturbing complications must at first be supportive, with parental fluids, transfusion and special nursing care. If peritonitis develops the outlook becomes extremely serious. Treatment according to the Ochsner principles should be carried out, with morphine adequate to put the intestines at rest and maintain their tone, plus high Fowler's position, gastroduodenal drainage, hot poultice to the abdomen, and use of the rectal tube. Every supportive measure should be considered in an attempt to avert the usually rapid downhill course when general peritonitis has developed. If signs of a walled off intra-abdominal abscess develop, as illustrated above, the patient should be prepared for secondary operation, any abscess evacuated with suction, and drained. The outlook here is more favorable.

**Fistula.** The occurrence of pancreatic or biliary fistulae, demonstrable by the drainage of pancreatic ferments (thin watery discharge) or bile, or both, usually means injury to the common bile or pancreatic ducts at the time of operation. This may occur during a very low resection of the second portion of the duodenum in an attempt to remove a posterior wall ulcer; during extensive mobilization of the duodenum; or during an attempt to control hemorrhage behind the duodenum. A pancreatic fistula generally arises from injury to an accessory pancreatic duct rather than to the body of the pancreas itself.

In treatment of this serious complication, reconstructive surgery must often

be resorted to before recovery is assured. If autolytic pancreatic ferments (trypsin, pancreatin, amylase, lipase) are present, they must be inactivated with a continuous drip of peptone and dilute hydrochloric acid into the depth of the fistula. Constant suction drainage applied through a small catheter in the wound is very valuable. If the fistula is small it may heal without further measures. Persistent pancreatic and biliary fistulae, however, may well require additional surgery, namely, transplantation either of the fistulous tract or of the cut common duct into the duodenum or stomach.

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# PYOGENIC ABSCESS OF THE LIVER\*

## II. AN ANALYSIS OF FORTY-SEVEN CASES WITH REVIEW OF THE LITERATURE

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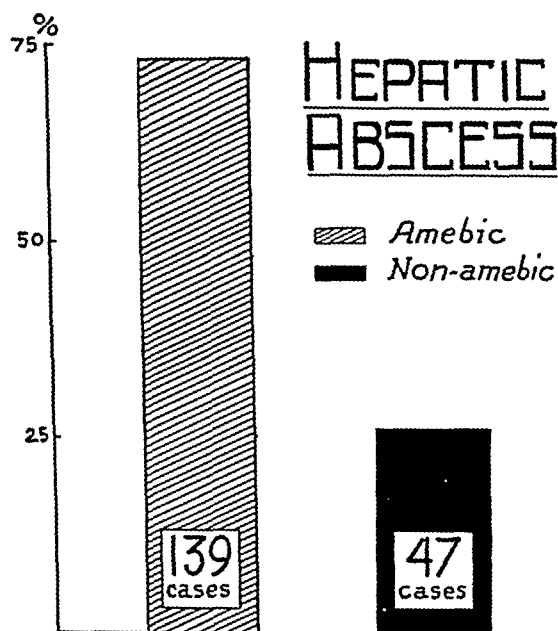
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**D**URING the past quarter century many valuable contributions have been made toward a more rational

this report is based upon a study of the latter.

### INCIDENCE



GRAPH 1. Incidence of amebic and non-amebic abscess of the liver in a total of 186 cases of hepatic abscess.

conception of hepatic abscess. The etiologic, pathologic, prognostic, and therapeutic differences existing between amebic and pyogenic hepatic abscesses are universally well established and a rational consideration of liver abscess is possible only after this differentiation is made. With this distinction in mind, 186 cases admitted to Charity Hospital and Touro Infirmary in New Orleans during the ten-year period, 1928 to 1937 inclusive, have been analyzed. Of this number, 139 (74.7 per cent) were amebic abscesses and 47 (25.2 per cent) were pyogenic. (Graph 1.) The former will be considered in another publication,<sup>1</sup> and

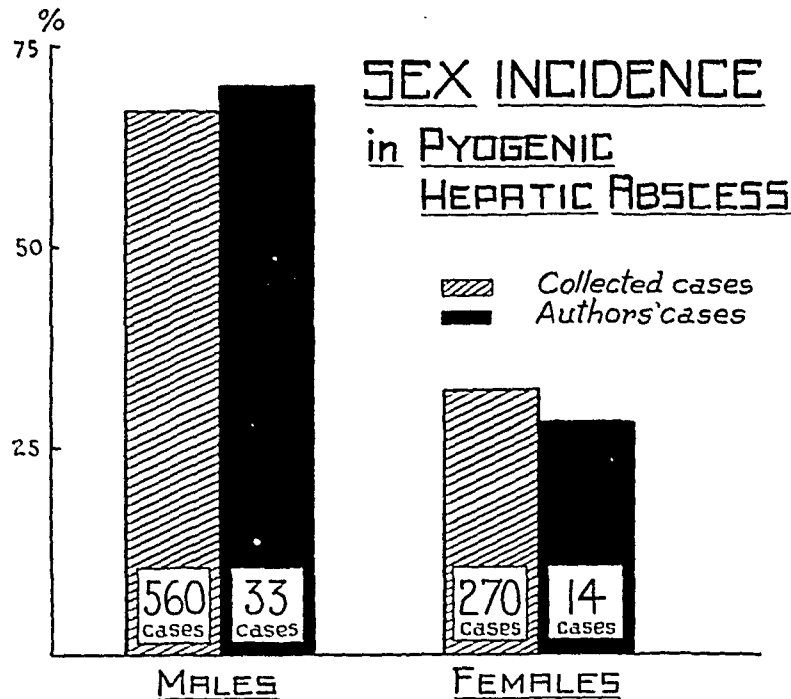
A true estimate of the frequency of this condition is not possible as the diagnosis cannot always be made, and it is undoubtedly missed in many of the cases not coming to autopsy. Among 17,204 autopsies, Kobler<sup>2</sup> found seventy-nine cases with liver abscess (0.45 per cent). Collins<sup>3</sup> found, in 18,300 autopsies, 111 (0.606 per cent) cases of septic liver abscess. In 1875, Baerensprung<sup>4</sup> found 108 (1.47 per cent) liver abscesses in 7,326 autopsies. This unusually high percentage probably can be explained by the large number following infections (50.9 per cent) either with or without injury which occurred during the pre-Listerian period. During a twenty-one-year period, Dudley<sup>5</sup> reported that there were 28,034 patients admitted to the Zurich Clinic, and of this number there were twelve cases of liver abscess, an incidence of 0.04 per cent. At the Pennsylvania Hospital during a twenty-five-year period, liver abscess occurred in approximately 0.04 per cent of the total admissions, according to Norris and Farley.<sup>6</sup> In their reported series of fifty-two abscesses of the liver, they found that six (11.5 per cent) were amebic and forty-six (88.4 per cent) were pyogenic.

During the ten-year period, 1928 to 1937, inclusive, there were 540,776 total admissions to the Charity Hospital, among which there were 160 abscesses of the liver, an incidence of 0.029 per cent. In this series there were forty-two (0.0077 per cent) pyogenic abscesses of the liver.

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During this same period there were 1,152 patients diagnosed as having liver disease, of which 10.2 per cent were amebic

be in better general health than clinic patients. However according to Craig<sup>10</sup> both incidences would be much higher if



GRAPH II. Sex incidence in 830 collected cases of pyogenic hepatic abscess and 47 cases of the authors.

abscesses and 3.6 per cent were pyogenic abscesses. In our total series of 186 cases of hepatic abscess, pyogenic abscesses constituted 25 per cent. Although the relative incidence of amebic abscess is considerably greater in our series (75 per cent) than in Norris and Farley's (11.5 per cent),<sup>6</sup> it is our opinion that this difference cannot be accounted for solely by the slightly greater incidence of amebiasis in the South. According to Craig,<sup>7</sup> the incidence of amebiasis is probably about three times greater in the South than in the North. Reports on the incidence of amebiasis in the two regions demonstrate this fact. Wenrich, Stabler and Arnett<sup>8</sup> made routine stool examinations on 1,060 college freshmen at the University of Pennsylvania and found the incidence of amebiasis to be 4.1 per cent. Similar examinations made by Faust and Headler<sup>9</sup> on 4,270 white clinic patients in New Orleans showed the incidence to be 8.3 per cent. Whereas the latter incidence appears to be twice as great as the former, it should be observed that college freshmen would be expected to

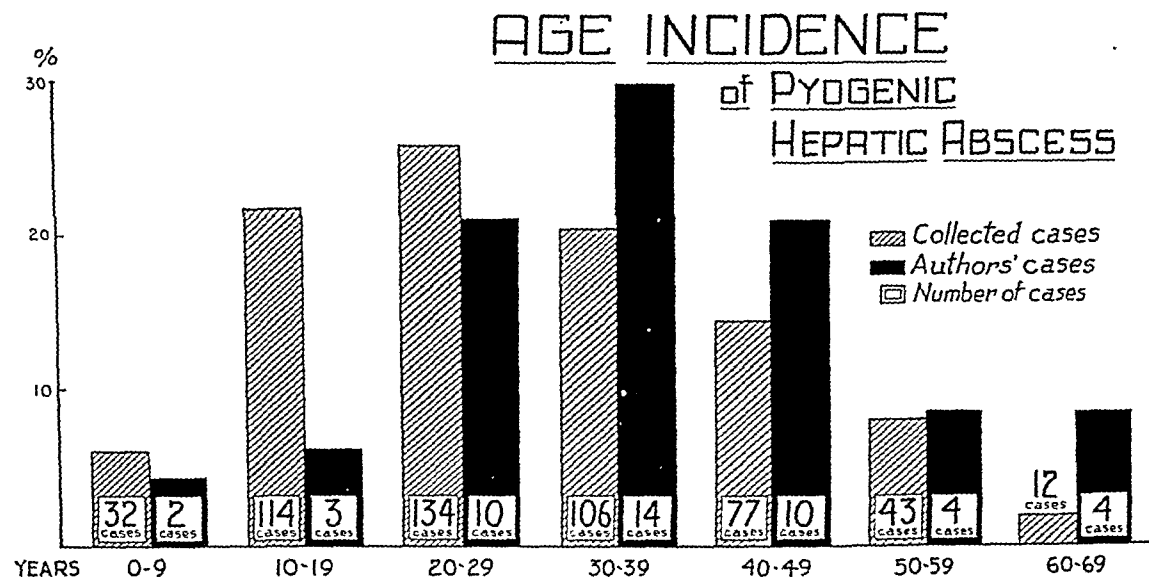
repeated stool examinations were made on each individual. The relative frequency of amebiasis in the temperate climates is not fully realized, and consequently the possibility of amebic hepatic abscesses is likely not to be considered.

The sex incidence in this condition, as in amebic liver abscess, revealed a predominance in the male and is probably explained by the fact that the etiologic agents occur more frequently in the male. Petren,<sup>11</sup> in a collected series including his own, found 198 (57.3 per cent) males and 147 (42.6 per cent) females. Of Brown's<sup>12</sup> sixty-three cases, forty-two (66.6 per cent) were males and twenty-one (33.3 per cent) were females. Rothenberg and Linder,<sup>13</sup> in an analysis of twenty-four cases, found seventeen (70.8 per cent) males and seven (29.1 per cent) females. Collins<sup>3</sup> records thirty-nine (78 per cent) males and eleven (22 per cent) females in a series of fifty cases. In a collected series of 830 cases of liver abscess there were 560 (67.4 per cent) males and 270 (32.5 per cent) females, which corresponds to the 70.2 per cent

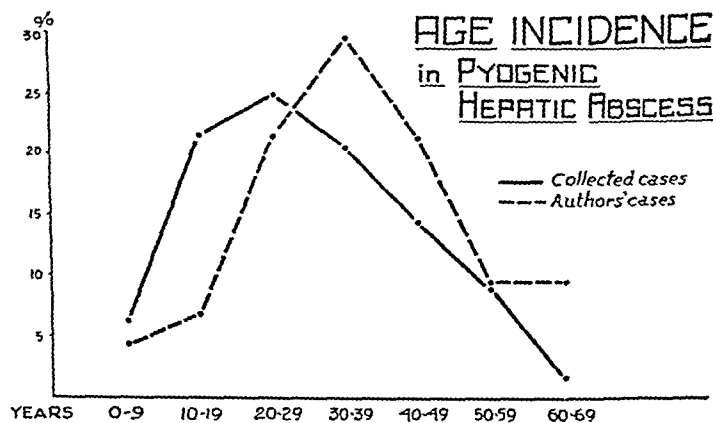
male and 29.7 per cent female incidence in our group of forty-seven cases. (Graph II.)

In the reported cases, hepatic abscess observed from Graph IV that the com-

mensurably higher incidence of liver abscess in the collected series is one decade



GRAPH III. Age incidence of pyogenic hepatic abscess according to decades in 518 collected and 47 authors' cases.



GRAPH IV. Comparative age incidence in 518 collected cases and 47 authors' cases.

occurred principally in relatively young adults. Petren<sup>11</sup> found the greatest incidence in the third decade in a collected series and in the fourth decade in his own series. Eliason<sup>14</sup> reports the greatest frequency during young adult life. On the other hand, Rothenberg and Linder<sup>13</sup> found the greatest age incidence between forty and fifty years. Whereas in a collected series of 518 cases the greatest age incidence was in the third decade, in our series of forty-seven cases, this was in the fourth decade. (Graph III.) It will also be

younger than in our series. This can probably be explained by the fact that in the collected series there is a considerably greater preponderance of appendicitis as the original lesion than in our cases. In our series the youngest was one and one-fourth years and the oldest 66 years of age.

There is apparently no racial susceptibility in pyogenic liver abscess. As there are no colored patients admitted to Touro Infirmary, only the Charity Hospital group of our series can be considered. In this group of 42 cases, there were 22 (52.3 per

cent) white and 20 (47.6 per cent) colored patients, showing an approximately equal distribution between the two races. As the admissions for the two races were about equal, this incidence is absolute and not relative.

### ETIOLOGY

Pyogenic hepatic abscesses are the result of invasion by pyogenic microorganisms and can occur in the following ways:

1. Transportation of virulent microorganisms through the portal vein from areas drained by the portal system
  - (a) Appendix
  - (b) Rectum
  - (c) Other portions of the bowel
2. Extension from contiguous diseased processes
  - (a) Cholecystitis and cholangitis
  - (b) Gastric and duodenal ulceration
  - (c) Subphrenic space infection
3. Trauma
  - (a) Penetrating injuries with the introduction of microorganisms from without
  - (b) Subcutaneous injuries producing devitalization of liver tissue permitting growth of microorganisms already present in the liver
4. Blood-borne infections with the production of metastatic abscesses, the microorganisms being transported through the hepatic arteries.

Although the routes of extension of the infection frequently can be demonstrated, in many instances the cause of the hepatic abscess is not obvious, i.e., is cryptogenic.

Undoubtedly one of the most frequent antecedent lesions in pyogenic abscess of the liver is suppurative appendicitis which is complicated by portal thrombophlebitis (pylephlebitis). In a collected series of 575 cases, there were 197 (34.2 per cent) cases in which appendicitis was the etiologic agent. (Graph v.) However, in our series of forty-seven cases, appendicitis was

the exciting lesion in only five (10.6 per cent). This discrepancy can probably be accounted for by the fact that many of the reports represented primarily the authors' interest in pylephlebitis and liver abscess as complications of appendicitis with complete disregard of liver abscess due to other causes. This is corroborated by the fact that in those series which include pyogenic liver abscess due to all causes the incidence of appendicitis more nearly approximates ours. In a total series of 231 cases of liver abscess reported by Barenstrup,<sup>4</sup> Rothenberg and Linder,<sup>13</sup> and Keefer<sup>15</sup> appendicitis was the etiologic agent in only thirty-one (13.4 per cent). The incidence of portal thrombophlebitis and liver abscess following appendicitis varies from a little more than 1 per cent to less than 0.1 per cent. Petren<sup>11</sup> stated that liver abscess or suppurative pylephlebitis of the portal vein occurred in from 0.3 to 0.4 per cent of all cases of appendicitis and that these complications occur in at least 5 per cent of all fatal cases of appendicitis. In a collected series of 68,198 cases of appendicitis,<sup>11,14,16-58</sup> there were 247 cases with these complications, an incidence of 0.36 per cent. (Table 1.) In our series there were 5,293 cases of acute appendicitis during the ten-year period, 1928 to 1937 inclusive, with five cases complicated by liver abscess, an incidence of 0.094 per cent.

Pyogenic liver abscess can be caused by lesions in the portal area other than appendicitis. Such lesions include gastrointestinal ulceration, either primary or secondary, diseases of the rectum, spleen, and pancreas, which cause pyogenic hepatic abscess much more frequently than is commonly supposed. This is clearly demonstrated by the fact that they form 10.2 per cent of all causes in the collected series and 8.4 per cent in the authors' series. (Graph v.) In rare instances hepatic abscess can occur in infants as the result of extension of infection from the umbilicus through the umbilical veins. Kutsunai<sup>59</sup> collected seven such reported cases and described two additional ones.

Pyogenic hepatic abscess can also be caused by direct extension from contiguous suppurative processes. Although such an

TABLE I  
INCIDENCE OF PYOGENIC HEPATIC ABSCESS IN  
APPENDICITIS

Authors	Year	Appendicitis	Liver Abscess
Matterstock <sup>16</sup>	1880	146	11
Fitz <sup>17</sup>	1886	257	11
Borchardt <sup>18</sup>	1897	378	5
Armstrong <sup>19</sup>	1897	517	5
Coley <sup>20</sup>	1900	200	2
Rehn <sup>21</sup>	1901	180	1
Sonnenburg <sup>22</sup>	1902	3,048	3
Gerster <sup>23</sup>	1903	1,189	8
Bornhaupt <sup>24</sup>	1903	268	3
Reisinger <sup>25</sup>	1904	370	4
Körte <sup>26</sup>	1905	1,000	20
Hawkins <sup>27</sup>	1905	947	2
Clogg and Fairbanks <sup>28</sup>	1905	125	1
Lockwood <sup>29</sup>	1905	200	2
Lett <sup>30</sup>	1905	1,000	4
Gask <sup>31</sup>	1905	1,170	1
Moschcowitz <sup>32</sup>	1907	1,529	7
Martens <sup>33</sup>	1907	503	2
Henking <sup>34</sup>	1907	279	2
Bell <sup>35</sup>	1908	1,726	8
Giertz <sup>36</sup>	1909	533	4
Fromme <sup>37</sup>	1911	647	3
Gümbel <sup>38</sup>	1911	236	1
Krogius <sup>39</sup>	1911	1,283	2
Hoffman <sup>40</sup>	1912	4,000	7
Baradulin <sup>41</sup>	1913	417	1
Braun <sup>42</sup>	1913	600	4
Petrén <sup>43</sup>	1914	4,204	15
Stillman <sup>44</sup>	1915	1,748	2
Short <sup>45</sup>	1918	1,000	4
Gibson <sup>46</sup>	1919	782	1
Brütt <sup>46</sup>	1922	2,500	15
Colp <sup>47</sup>	1926	2,841	9
Eliason <sup>48</sup>	1926	2,237	3
Reök <sup>49</sup>	1927	564	3
Demjanovitz <sup>50</sup>	1927	3,046	6
Quain and Weldschmidt <sup>51</sup>	1928	1,000	1
Otschkin <sup>51</sup>	1932	1,762	15
Koster and Kasman <sup>52</sup>	1933	1,027	3
Finney <sup>53</sup>	1933	3,913	3
Lemberg <sup>54</sup>	1934	2,323	7
Stewart-Wallace <sup>55</sup>	1935	5,471	5
Snyder, Hall, and Allen <sup>56</sup>	1935	8,969	27
Stewart <sup>57</sup>	1936	600	1
Sprague <sup>58</sup>	1938	1,463	3
Totals		68,198	247 (0.36%)
Authors		5,293	5 (0.094%)

extension most commonly arises from disease of the gall-bladder, other rarer causes are subphrenic space infection resulting from intraperitoneal suppurative lesions, empyemata, nephritic or perinephritic lesions, and appendicitis. Cholecystitis was found to be the cause of liver abscess in 14 per cent of the 575 collected cases and in 6.3 per cent of the authors' forty-seven cases. (Graph v.)

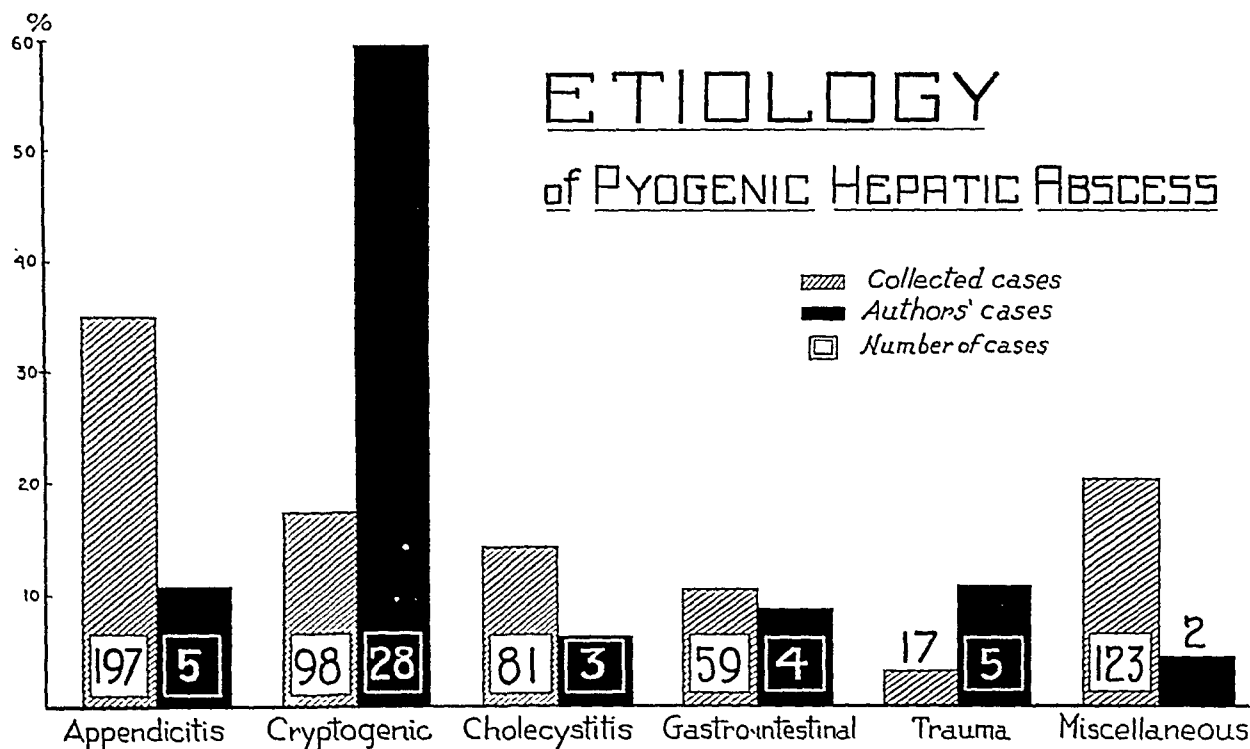
Whereas trauma is usually considered as a rare cause of liver abscess, it is obvious from Graph v that its significance has not been fully realized. In the collected series of 575 cases of pyogenic abscess there were seventeen (2.9 per cent), and five (0.6 per cent) in the authors' forty-seven cases, in which trauma was the causal agent. It is indeed surprising that injury to the liver is not a more frequent cause of hepatic abscess, as this organ is one of the most frequently injured abdominal viscera.<sup>60</sup> Liver abscess may follow trauma as a result of a penetrating injury which carries microorganisms into the liver substance or as a result of a subcutaneous injury producing devitalization of liver tissue and hematoma, permitting growth of microorganisms always present in the liver.

Liver abscess may be produced by microorganisms being transported through the hepatic artery from distant foci. Such blood-borne infections may be due to furunculosis, osteomyelitis, ulcerative endocarditis, upper respiratory tract infections, and any condition in which there is generalized sepsis. Of the 575 collected cases of liver abscess, approximately 13 per cent were due to metastatic infections of this type.

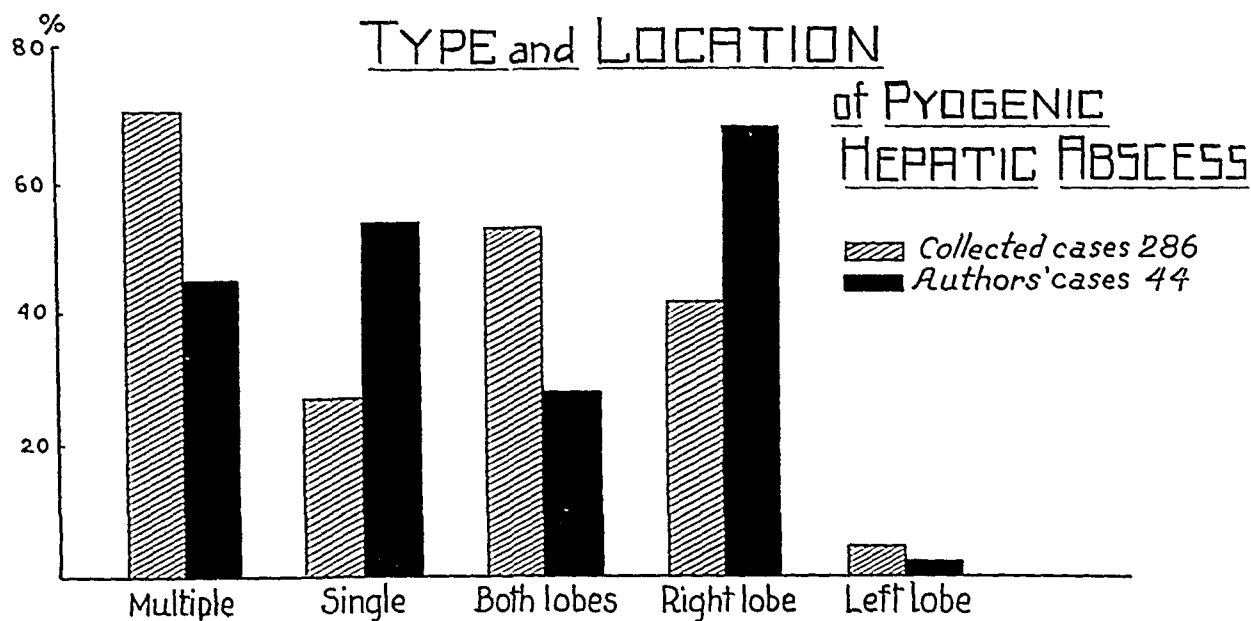
Finally, there is a relatively large group of pyogenic hepatic abscesses in which the antecedent lesion cannot be determined and which for this reason have been termed "cryptogenic," idiopathic, or primary pyogenic liver abscesses. Rothenberg and Linder<sup>13</sup> are of the opinion that such abscesses are the result of hematogenous infections due to distant foci which may be so inconspicuous as to be completely

overlooked. However, Beaver<sup>61</sup> has expressed the belief that in most of these the microorganisms are transported through

is clearly demonstrated in Graph v. Whereas in the collected series of 575 cases this group constitutes 17 per cent, in the



GRAPH V. Etiology in 575 collected cases and 47 authors' cases of pyogenic hepatic abscess. Of the 123 collected cases designated by the term miscellaneous, 13 per cent had generalized sepsis. One of the two cases of the authors in this group was due to a cystitis and the other to a secondarily infected gumma of the liver.



GRAPH VI. Relative incidence of the types and the localization of pyogenic hepatic abscess based upon 286 collected and 44 authors' cases.

the portal vein and that the antecedent lesions in the portal area are of such minor character that they are not recognized clinically. The importance of this group

authors' series of forty-seven cases it represents the largest number (59.5 per cent). This considerably greater incidence in the authors' series than in the collected

cases can be explained by the fact that in the collected cases there was a preponderance of appendicitis as the etiologic agent. In many large reported series, hepatic abscess complicating appendicitis only was considered. The antecedent lesion, appendicitis, is more readily diagnosed than other causes of hepatic abscess, which obviously increases the incidence of appendicitis as an etiologic agent in the reported series.

#### BACTERIOLOGY

The most frequently found organisms in pyogenic hepatic abscess are *B. coli*, streptococci, staphylococci, or a combination of these. In a collected series of 184 cases, *B. coli* was found to be the causal agent in 30.4 per cent, streptococci in 26.6 per cent, staphylococci in 26 per cent, and a combination of these in 13.5 per cent. In the authors' series of twenty-nine cases which were studied bacteriologically, these incidences were 31 per cent, 20.6 per cent, 17.2 per cent, and 17.2 per cent, respectively. Other microorganisms which rarely cause hepatic abscess are *B. aerogenes* capsulatus, *B. pyocyaneus*, and *B. typhosus*. Some of the organisms which have rarely been isolated in hepatic abscess are leptothrix,<sup>62</sup> streptothrix,<sup>63</sup> salmonella,<sup>64</sup> spirochetes,<sup>65</sup> and gonococci.<sup>66</sup> On the other hand, the pus in pyogenic liver abscess is found not infrequently to be sterile. Giordano,<sup>67</sup> Elsberg,<sup>68</sup> and Rothenberg and Linder<sup>13</sup> found that in their series of cases the pus was sterile in 58.4 per cent, 60 per cent, and 45.8 per cent, respectively. In the authors' series there were eleven (37.9 per cent) of twenty-nine cases in which the pus was sterile. Blood cultures in pyogenic hepatic abscesses are usually sterile.

#### PATHOGENESIS AND PATHOLOGY

The relative infrequency of abscesses of the liver as compared with other intra-abdominal infections is at first somewhat astonishing. Because of its direct vascular communication through the portal circulation with almost all of the abdominal

viscera, its systemic blood supply by way of the hepatic arteries, its intimate biliary system, and its communicating lymphatic channels, the opportunities for infection and abscess formation are obviously multitudinous. On the other hand, its plentiful blood supply, its characteristic sinusoidal vascular structure with freely moving blood, and its possessive phagocytic reticulo-endothelial cells afford numerous and competent factors of immunity against the localization of infection and the development of abscess. As has been outlined above, extension of infection to the liver can occur through the portal veins by areas drained by the portal system, from contiguous viscera including the biliary system, by penetrating injuries, and metastatic abscesses through the hepatic arteries. The lymphatic route as a mode of extension is conspicuously absent in this outline. Although Munro<sup>69</sup> has emphasized particularly this route of extension, there seems to be universal agreement among investigators that infection of the liver very rarely, if ever, occurs in this manner. Another unusual method of extension of infection from the appendix to the liver is by the retroperitoneal route (Loison,<sup>70</sup> Körte,<sup>26</sup> and Walter-Sallis<sup>71</sup>).

Probably the most frequently attributed antecedent lesion in pyogenic abscess of the liver is suppurative appendicitis. Whereas the most frequent cause of hepatic abscess in general is undeniably amebiasis, Bruggeman,<sup>72</sup> as late as 1917, stated that in the non-tropical countries appendicitis is the most common cause of hepatic abscess. Undoubtedly, appendicitis plays a frequent rôle in the causation of pyogenic hepatic abscess, but, as was emphasized above, its frequency has probably been overestimated. The first report of appendicitis complicated by multiple liver abscess is generally conceded to Waller,<sup>73</sup> in 1846. Hillairet,<sup>74</sup> in 1849, and Buhl,<sup>75</sup> in 1854, reported similar cases. Although following these first reports there were others who made note of its occurrence, including Reginald Fitz<sup>17</sup> in his

classic contribution on appendicitis, the French clinicians deserve greatest credit for their early realization of its importance

appendix and be transported through the contributing venous channels and portal vein to the liver. (Fig. 1.) This

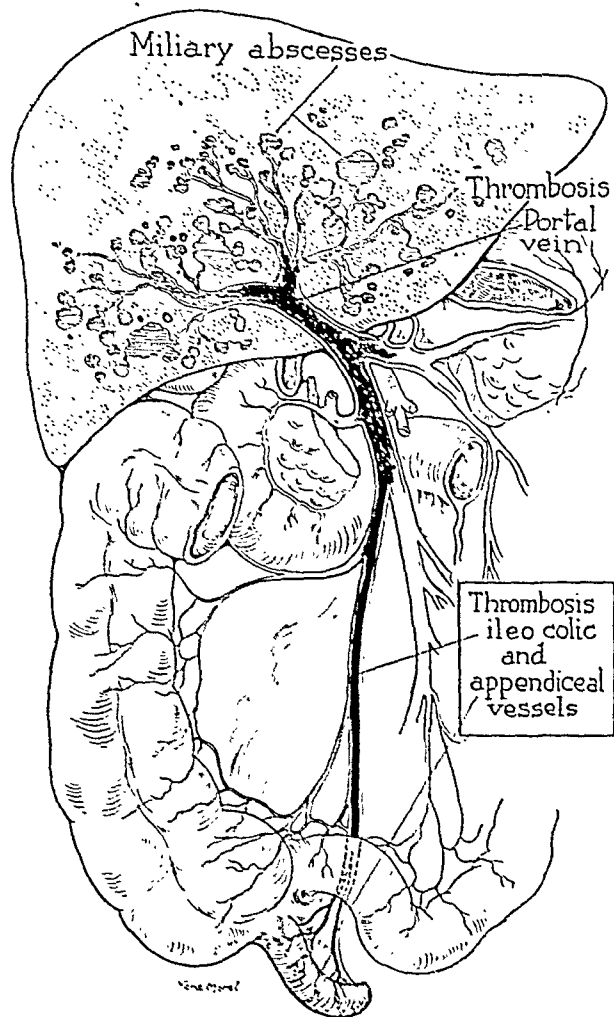
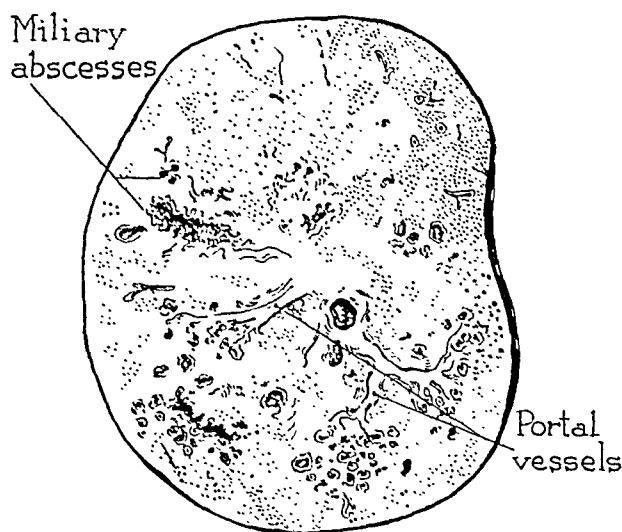


FIG. 1. Diagrammatic drawing illustrating pathogenesis of multiple abscess of liver following acute appendicitis. Pyothrombosis involves progressively the appendiceal veins in the meso-appendix, the ileocecal and ileocolic, the superior mesenteric, and finally the portal veins.

and for according it due consideration. This is well exemplified by Dieulafoy's<sup>76</sup> term "la foie appendiculaire."

The proper genesis of this infection is rather easy to follow. In the course of inflammation of the appendix, thrombophlebitis of the appendiceal intramural vessels invariably occurs. The phlebitis can involve progressively the appendiceal veins in the meso-appendix, the ileocecal, the superior mesenteric, and the portal veins, or a small septic embolus can become detached from the thrombus in the immediate neighborhood of the inflamed



Cross section-Dome of liver

FIG. 2. Diagrammatic drawing of cross section through right lobe of liver in multiple pyogenic abscess following pylephlebitis. The grape-like grouping of abscesses clustered about terminal branches of portal vein is characteristic of this pathologic process.

is the manner of development of the classical liver abscess which follows appendicitis. These abscesses are usually multiple and for the most part occupy the right lobe. (Fig. 2.) The explanation for the latter lies in the experimental work of Séregé,<sup>77</sup> Glenard,<sup>78</sup> Bartlett, Corper and Long,<sup>79</sup> and Dick and Copher,<sup>80</sup> who have demonstrated the existence of two currents of blood in the portal vein, one from the superior mesenteric which goes to the right lobe and one from the inferior mesenteric and splenic veins which goes to the left lobe.

Lesions in the portal area other than appendicitis may cause pyogenic hepatic abscess by extension of infection via the portal route. Thus infected hemorrhoids, proctitis, diverticulitis, bacillary dysentery, and carcinoma and ulcerations of the intestinal tract all may cause liver abscess by extension of infected emboli or thrombi by way of the portal tributaries to the liver substance.

As has been stated above, pyogenic hepatic abscess can be caused by direct



extension from contiguous suppurative processes. Thus gastric or duodenal ulceration with localized abscess formation may

the small veins of the bile ducts. This usually produces multiple abscesses involving practically the entire liver and closely



FIG. 3. Photograph of upper surface of liver from case of multiple pyogenic hepatic abscess. The small abscesses studding the surface of the liver may give the erroneous impression of multiple metastatic nodules from a distant neoplasm.

extend through the hepatic capsule and in this way produce an abscess of the liver. In rare instances infection of the pleural cavity may penetrate directly through the diaphragm into the liver. However, the most common type of pyogenic hepatic abscess due to direct extension is caused by disease of the gall-bladder and bile ducts. In cholecystitis associated with cholelithiasis, calculi occasionally penetrate the gall-bladder bed and involve the liver substance, or the gall-bladder ruptures into the hepatic parenchyma with eventual production of liver abscess.<sup>81</sup> However, suppurative cholangitis is the most common mechanism by which multiple liver abscess develops from cholelithiasis and cholecystitis. As a result of biliary stasis associated with infection, there is a spread of inflammation through the biliary tract, or pylephlebitis may supervene on cholangitis by extension of infection along the portal spaces via the lymphatics or

resembles the classical abscesses which follow appendicitis.

There are two ways in which trauma may cause liver abscess, i.e., penetrating injuries which carry microorganisms to the liver substance, or as a result of subcutaneous injury with consequent hematoma formation and devitalization of liver tissue, permitting growth of microorganisms already present in the liver. Obviously those types of injuries which produce greater destruction of liver tissue are more likely to be followed by infection and abscess formation. These abscesses are usually single and well localized. Cases belonging in this category have been reported by Waring,<sup>82</sup> Waterworth,<sup>83</sup> Young,<sup>84</sup> Massari,<sup>85</sup> and Townsend.<sup>86</sup> Liver abscess resulting from penetration of foreign bodies have been reported by numerous observers. Lambert<sup>87</sup> reported a case resulting from the passage of a pin through the stomach into the right lobe. Other

unusual penetrating foreign bodies are fish bone,<sup>88,89,90</sup> piece of glass,<sup>91</sup> and a fragment of straw.<sup>92</sup> A rare but interesting mechanism by which liver abscess is

involvement may vary, being either more or less generalized, or localized to some particular segment by the formation of limiting clots.

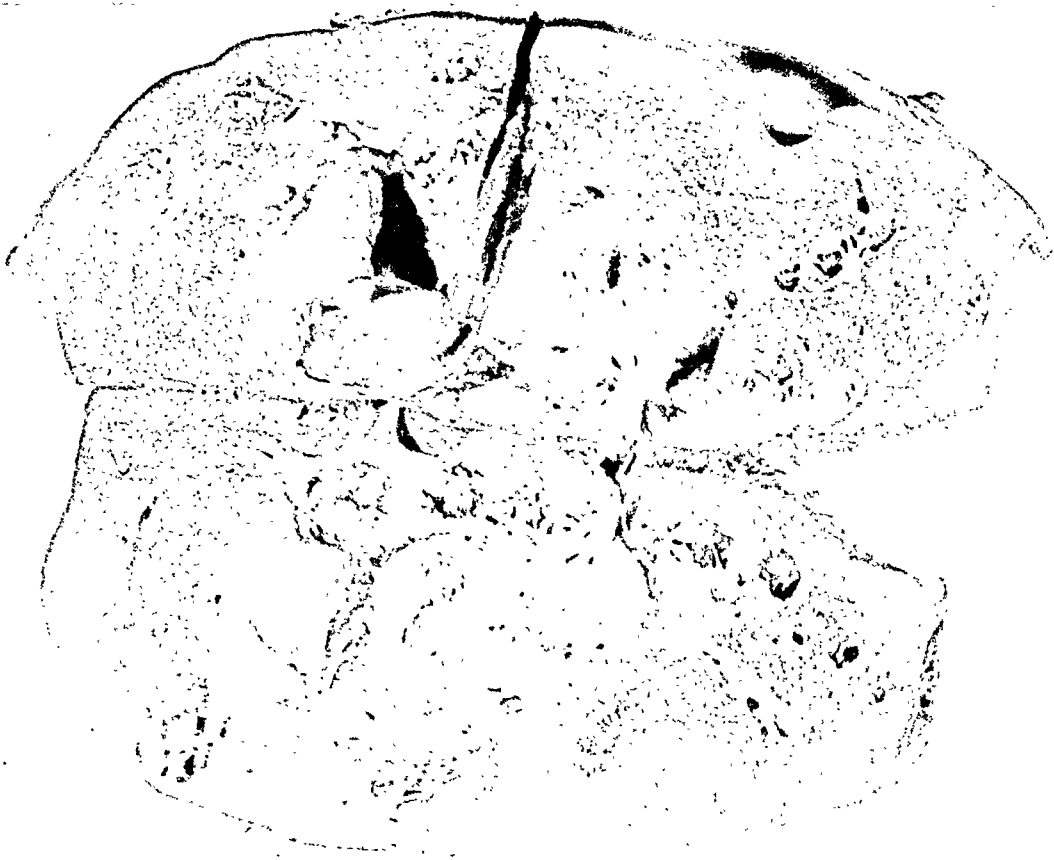


FIG. 4. Photograph of section through liver from case of pyogenic hepatic abscess, showing gross appearance of abscess formation. Small, lighter areas indicate early involvement. In other portions of liver small abscesses may be seen which are still single; others are partially coalesced, and additional sites show large abscess cavities resulting from confluence of smaller areas imparting honeycombed appearance to the diseased organ.

produced has been reported by Huard et al.<sup>93</sup> In this case the hepatic abscess resulted from the invasion of the liver by ascarides, apparently by way of a previously formed cholecystogastrostomy.

In suppurative pylephlebitis, the portal vein and its branches are found to contain pus and disintegrated blood clots. Either constituent may predominate in any particular case. Dilatation of the veins is a characteristic finding and is due to a weakening of the walls of the vessels, resulting from the inflammatory process, with subsequent bulging. Further involvement of the vessel may lead to perforation, facilitating the escape of pus into the surrounding hepatic tissue. The extent of vessel in-

Enlargement of the liver almost invariably occurs and in some instances its weight is doubled. A perihepatitis is commonly found, due to involvement of Glisson's capsule, and occasionally causes adherence to the diaphragm. Coagulation necrosis preceding suppuration may give the erroneous impression of multiple metastatic nodules from a distant neoplasm, and sometimes abscesses near the surface may be misleading. (Fig. 3.) The organ itself presents a mottled appearance, the areas of abscess formation being of a pale yellow in contrast to the deep maroon of uninvolved hepatic tissue.

On section the abscesses, when multiple, may be seen scattered throughout the liver

substance or, in some cases, more or less confined to particular sections, the left lobe escaping involvement more often than

lobe alone was involved in 41.8 per cent, the left lobe in 4.8 per cent, and both lobes in 53.2 per cent. In the authors' series

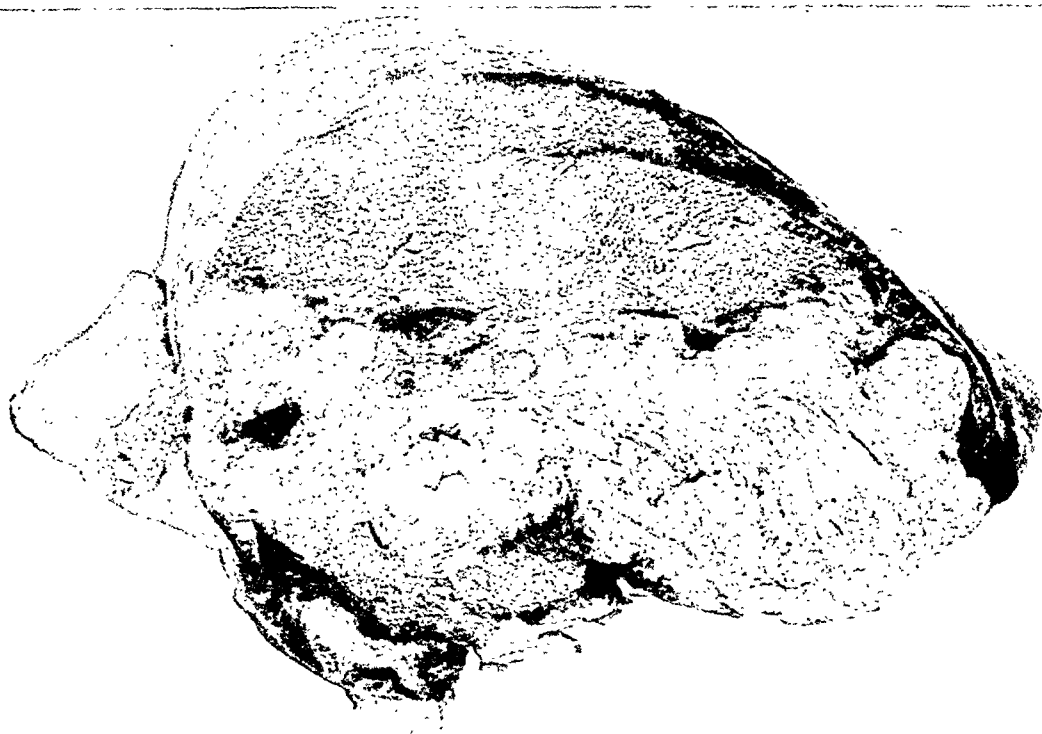


FIG. 5. Gross section of liver in the chronic type of pyogenic hepatic abscess. An abscess cavity may be seen with a wall almost as thick as the diameter of the defect itself. Another cavity, more centrally located, is almost obliterated by fibroblastic proliferation. Still areas reveal the characteristic extensive fibrous tissue formation in this type of pyogenic hepatic abscess.

the right. These necrotic areas may vary in size from a fraction of a millimeter to a centimeter or more. By coalescence, small abscesses form larger cavities, or, in some cases, adjacent necrotic areas impart a honeycombed appearance to the diseased organ. (Fig. 4.) Destruction of the parenchyma may take place to such an extent that only a shell of the liver remains. Cases occur in which a solitary cavity is the only lesion resembling the typical amebic abscess in gross configuration. These chronic cases are characteristically long-standing with fibrous tissue formation and have been excellently described by Beaver.<sup>61</sup> (Fig. 5.)

Whereas in the collected series of pyogenic hepatic abscesses only 28.8 per cent were single, in our series there were 54.5 per cent. In the collected cases the right

these incidences were 68.1 per cent, 2.2 per cent, and 27.2 per cent, respectively. Whereas in the collected cases 71.1 per cent were multiple, in the authors' series only 45.4 per cent were multiple. (Graph VI.) This discrepancy is probably due to the considerably greater incidence of appendicitis in the collected cases. This is supported by the fact that of the twenty-four cases of single pyogenic liver abscess reported by Rothenberg and Linder,<sup>13</sup> only one was caused by appendicitis.

Microscopically, in pylephlebitis, round cell infiltration of the venous wall is seen, and leucocytes and cellular detritus are present in the lumen. Adjacent liver cells exhibit reaction to the inflammatory process with various stages of degeneration usually being demonstrable.

Cellular necrosis characterizes the areas of abscess formation, the central portions of larger lesions containing practically

cent) of the authors' forty-seven cases. (Graph VII.) The pyrexia may be remittent, intermittent, or occasionally continuous,



FIG. 6. Photomicrograph of section through pyogenic liver abscess showing area of necrosis, diffuse cellular infiltration, and, more centrally, fibrous tissue formation.

nothing but cellular detritus, while a fibrous capsule bounds the periphery. (Fig. 6.)

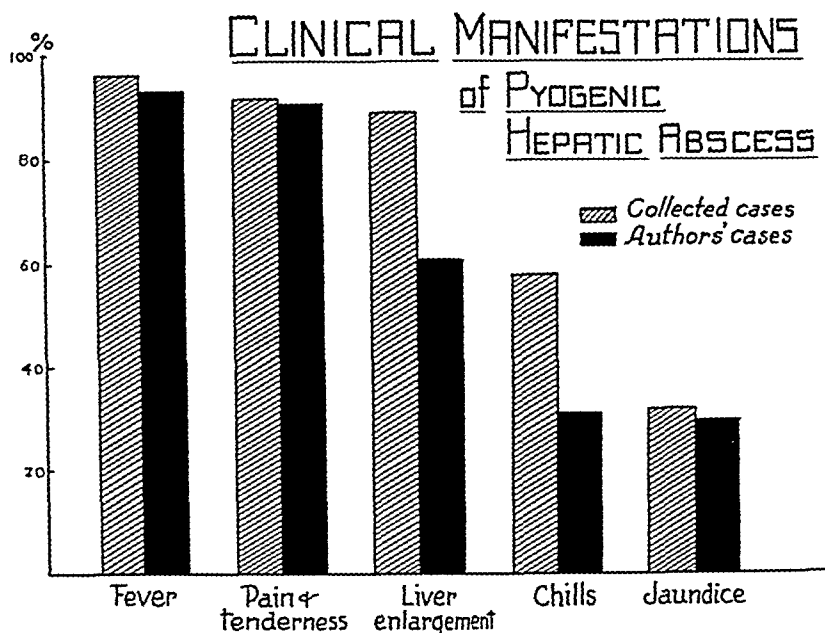
#### SYMPTOMS AND SIGNS

The symptoms and signs of pyogenic hepatic abscess may be divided into two groups, systemic and local. The most frequently encountered systemic manifestations are fever, pain, chills, and profuse sweating. Less frequently there occur malaise, anorexia, loss of weight, weakness, nausea, and vomiting. In a series of 286 collected cases, fever was present in 274 (95.8 per cent) and in forty-four (93.6 per

cent) but usually depends upon the type of onset, and whether the abscess is multiple or single. In the classical, multiple liver abscess associated with pylephlebitis and suppurative appendicitis, fever is characteristically of the "picket fence" type and is usually accompanied by daily chills. Whereas in the series of 286 collected cases in which the presence or absence of chills was mentioned, this occurred in 58.7 per cent, in our series of cases it was present in only 36.1 per cent. (Graph VII.) This discrepancy between the collected cases and the authors' series is undoubtedly due to the large incidence of appendicitis

and pylephlebitis with associated multiple liver abscesses in the former group. Rothenberg and Linder<sup>13</sup> observed that daily

pain on inspiration in the region of the right hypochondrium or right lower chest, probably due to involvement of the



GRAPH VII. Incidence of clinical manifestations of pyogenic hepatic abscess based upon 286 collected and 47 authors' cases.

chills occurred infrequently in cases with single abscess but were quite common in patients with multiple abscesses. The significance of chills followed by rapid rise of temperature during the course of appendicitis has been emphasized by Bryant,<sup>94</sup> Brown,<sup>12</sup> Gerster,<sup>23</sup> Babler,<sup>95</sup> Thalheimer,<sup>96</sup> Eliason,<sup>14</sup> Ochsner, Gage, and Garside,<sup>97</sup> and numerous others.

Pain is more likely to be dull and constant and is usually located in the right hypochondrium or epigastrium. Whereas Eliason<sup>14</sup> is of the opinion that pain cannot be regarded as of paramount importance in the diagnosis, Bryant,<sup>94</sup> Schwartz,<sup>98</sup> and Babler<sup>95</sup> have emphasized its significance. Pain was found to be present in 92.6 per cent of the collected cases and 91.4 per cent of the authors' cases. (Graph VII.) Radiation of pain to the right shoulder, probably due to phrenic irritation, has been observed by Dixon and Murphy,<sup>99</sup> although Rothenberg and Linder<sup>13</sup> are of the opinion that it occurs infrequently. These authors<sup>13</sup> also observed that over one-third of the patients complained of

diaphragmatic pleura. Attention has also been directed to localized intercostal pain.<sup>13,14,100</sup>

Anorexia, malaise, asthenia, and loss of weight are prominent manifestations and usually are of early occurrence. On the other hand, nausea and vomiting are not conspicuous complaints and were present in less than one-third of our cases.

The average duration of symptoms depends upon the type of onset. Of the twenty-four cases reported by Rothenberg and Linder<sup>13</sup> there were sixteen (66.6 per cent) with duration of symptoms of three weeks or less prior to hospitalization. This group constituted 42 per cent of our cases, with an average duration of eleven days. The shortest duration of symptoms before admission to the hospital was three days and the longest was 270 days. The longest duration in the hospital was 124 days and the average was twenty-nine days.

Of the local manifestations, tenderness in the hepatic area and liver enlargement are the most constant. Tenderness was present in all of Rothenberg and Linder's<sup>13</sup>

cases and hepatic enlargement in 91.6 per cent. The significance of these two signs is clearly demonstrated in Graph VII. Tenderness was present in 92 per cent of the collected cases and in 91.4 per cent of the authors'. Hepatic enlargement was elicited in 89.3 per cent of the collected cases and in 61.7 per cent of the authors' cases. (Graph VII.)

Occasionally in those instances in which a distinct bulging can be palpated there is redness and edema of the overlying skin, indicating involvement of the abdominal parietes. Whereas Eliason<sup>14</sup> stresses the importance of this sign, Rothenberg and Linder<sup>13</sup> did not observe it in any of their cases. Stevenson<sup>101</sup> reported it in only 5 per cent of his cases of amebic hepatic abscess.

Jaundice does not occur frequently except as a late manifestation, but when present is of grave significance. Whereas it was observed in only 8.3 per cent of the series reported by Rothenberg and Linder,<sup>13</sup> it occurred in 60 per cent of Collins's<sup>3</sup> cases. It was present in 36.4 per cent of the collected cases and in 24.7 per cent of the authors' cases. (Graph VII.)

Ascites is not a frequent manifestation. Whereas Snyder, Hall, and Allen<sup>56</sup> found it to be present in 22 per cent of their cases, Brown<sup>12</sup> observed it in only 6 per cent of the cases he reviewed. Rothenberg and Linder's<sup>13</sup> observation that ascites occurred in none of their cases is similar to ours. However, it is more likely to develop in cases of liver abscess associated with appendicitis and suppurative pylephlebitis.

#### LABORATORY FINDINGS

The only significant findings in examination of the urine are: (1) the presence of bile in those cases with jaundice; and (2) the presence of albumin in patients with marked toxemia.

Characteristically, in pyogenic hepatic abscess there is a leucocytosis with a proportionate increase in polymorphonuclear leucocytes. Rogers,<sup>102</sup> Manson-Bahr and Willoughby,<sup>103</sup> and Ochsner and

DeBakey<sup>104</sup> have emphasized that in amebic hepatic abscess there is a moderate increase in leucocytes as contrasted with the marked leucocytosis which is seen in bacterial hepatitis and abscess. Rothenberg and Linder<sup>13</sup> found the average leucocyte count to be 16,000 and the average polymorphonuclear leucocyte percentage to be 86. The blood picture undoubtedly depends upon the type of abscess and the character of onset. This is clearly demonstrated in Table II.

TABLE II  
BLOOD PICTURE

	Acute	Chronic	Total
Leucocytes			
Lowest.....	12,500	7,200	7,200
Highest.....	51,250	24,400	51,250
Average.....	26,924	14,077	19,698
Neutrophiles			
Lowest.....	75	56	56
Highest.....	94	84	94
Average.....	89	75.8	81.3
R.B.C.			
Lowest.....	2,385,000	1,850,000	1,850,000
Highest.....	5,075,000	4,775,000	5,075,000
Average.....	4,100,000	3,098,888	3,599,444
Hemoglobin			
Lowest.....	50	30	30
Highest.....	90	80	90
Average.....	61.6	58.8	60

The average leucocyte count in the acute cases in our series was almost twice as high as in the chronic, and the polymorphonuclear leucocytes showed a corresponding increase. In the chronic cases of pyogenic hepatic abscess there is usually an associated secondary anemia. Whereas the average red blood cell count was approximately normal in the acute cases of our series and definitely diminished in the chronic cases, the average hemoglobin in both groups is about equal. The only explanation we can offer for this curious finding is that the acute cases are more likely to be dehydrated, which results in ostensibly normal red blood cell counts.

Roentgenography is undoubtedly one of the most significant and reliable aids in the diagnosis of liver abscess. The charac-

teristic roentgenologic changes are elevation and immobility of the diaphragm, usually the right. In our experience these findings are of inestimable value. Pancoast,<sup>165</sup> Dickinson,<sup>166</sup> and Love<sup>167</sup> have emphasized the importance of these changes. Granger<sup>108</sup> has directed attention to the significance of the characteristic changes in the contour of the diaphragm in liver abscess alone and in that associated with subdiaphragmatic suppuration. We<sup>104,109,110,111</sup> have repeatedly corroborated his observation that in subphrenic abscess complicating liver abscess there is an obliteration of the cardiophrenic angle in the anteroposterior roentgenogram and obliteration of the anterior costophrenic angle in the lateral view, whereas in subphrenic abscess due to other causes there is an obliteration of the costophrenic angle in the anteroposterior view and obliteration of the posterior costophrenic angle in the lateral roentgenogram. Miles<sup>112</sup> has recently demonstrated that abscess of the left lobe of the liver produces characteristic pressure deformities on the barium-filled stomach. The lesser curvature assumes a crescentic shape, and the cardia and duodenal cap are displaced.

The value of roentgenography in the diagnosis of liver abscess is well exemplified in our series of cases. In twenty-eight cases with roentgenologic studies the diagnosis was positive in twenty-three, an incidence of 82.1 per cent.

Wilmoth<sup>113</sup> has suggested aspiration of liver abscess and injection of lipiodol followed by roentgenologic studies. Some investigators<sup>114,115,116,117</sup> have advocated aspiration of pus from hepatic abscesses and introduction of thorium dioxide into the cavity in order that the size, shape, and position of the abscess may be visualized on the roentgenogram. In the present state of insufficient knowledge regarding the end effects of thorium dioxide, this procedure appears unjustifiable to us, especially in a condition which can be so readily diagnosed. Rothenberg and Linder<sup>13</sup> have also expressed

this opinion. Such a procedure also seems unwarranted because of the danger of contaminating either the pleural or peritoneal cavities by the aspirating needle.

#### DIAGNOSIS

The diagnosis of pyogenic hepatic abscess is not attended with great difficulty if the condition is kept in mind and due consideration accorded the clinical manifestations and laboratory investigations. In a patient with localized pain and tenderness over the hepatic region and enlargement of the liver associated with pyrexia and chills, one should always consider the possibility of hepatic abscess. Also, if there is marked leucocytosis with a corresponding increase in polymorphonuclear leucocytes, one should be even more suspicious of hepatic infection. Characteristically, the pain and tenderness are well localized in the right hypochondriac or hepatic region, but may radiate to the right shoulder. If, in addition to such a clinical picture, there is present the characteristic fluoroscopic and roentgenologic findings already described, the diagnosis of liver abscess is justified. The findings in our series corroborate the observations of Rothenberg and Linder<sup>13</sup> that nausea and vomiting occur far less frequently in hepatic pyogenic abscess than in other intra-abdominal suppurative processes. In our series these symptoms occurred in only 18 per cent. The absence of nausea and vomiting in a patient with clinical manifestations of an intra-abdominal suppurative process, therefore, is of diagnostic importance.

From the prognostic and therapeutic standpoints it is important to differentiate multiple and single abscesses of the liver. Whereas this is not always possible, it usually can be done if careful consideration is given the onset and character of the condition. The classical type of multiple hepatic abscess associated with pylephlebitis and suppurative appendicitis should offer little difficulty in diagnosis. The antecedent suppurative appendicitis, the

sudden onset of chills, the high fever, the pain and tenderness extending upward from the right iliac region, the marked leucocytosis, and the obvious sepsis constitute a classical clinical picture. However, multiple abscess of the liver occurs in the absence of appendicitis, but in contrast to single pyogenic hepatic abscess there is usually an obvious, associated or antecedent lesion in the portal area. Aside from the fact that in single pyogenic hepatic abscess the onset is commonly insidious, and the source of infection is frequently impossible to determine, in contrast to multiple liver abscess in which the onset is usually sudden and acute and the source of infection is more likely to be obvious, there are other differential diagnostic aids. Fever and chills are not so likely to be prominent in single abscess and the leucocytosis not so high. As regards jaundice, our findings were similar to those of Rothenberg and Linder<sup>13</sup> in that it occurred most often in patients with multiple abscess.

It is also extremely important to differentiate pyogenic hepatic abscess from amebic abscess, especially before the amebic abscess becomes secondarily infected. Characteristically, amebic abscess of the liver presents an entirely different clinical picture. The onset is usually very insidious, the temperature is slightly or only moderately increased, chills occur very rarely, and the patient does not appear so severely ill as in pyogenic abscess. A history of previous dysentery as well as the presence of *Endameba histolytica* in the stool are confirmatory evidence of amebiasis.

Exploratory aspiration of the liver for the detection of pus in pyogenic hepatic abscess is an entirely unjustifiable and dangerous procedure in our opinion. The danger of contaminating an uninvolved serous surface (pleura or peritoneum) is always present. Moreover, the procedure is particularly unwarranted in a condition which can be so readily diagnosed. That this statement is not incorrect is borne out by the percentage of cases in which

a correct diagnosis was made in our series. Of the total forty-seven cases, a correct pre-operative diagnosis was made in thirty-four, an incidence of 72.3 per cent. There was an even higher incidence of correct diagnoses in those cases which were studied roentgenologically. Of the twenty-eight cases in which such an examination was made, twenty-three were correctly diagnosed, an incidence of 82.1 per cent.

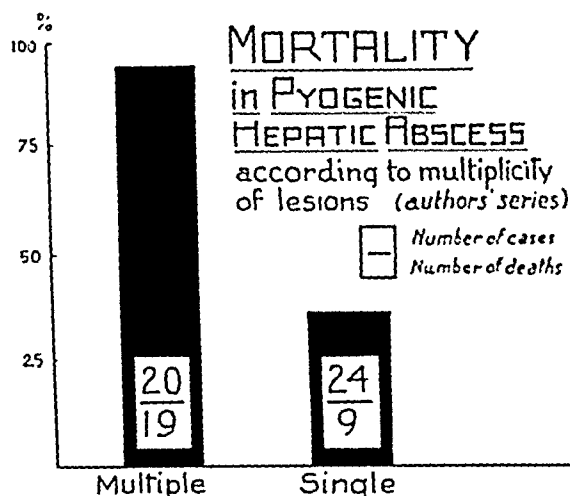
#### PROGNOSIS

Aside from the virulence of the organism and the resistance of the host, the prognosis in pyogenic hepatic abscess depends upon: (1) the multiplicity of the lesions and whether there is an associated pylephlebitis; (2) the presence or absence of complications; and (3) the type of drainage instituted. Multiple abscesses of the liver, especially associated with suppurative appendicitis and pylephlebitis, are characterized by a grave prognosis and a high mortality. Dieulafoy's<sup>76</sup> teaching that hepatic abscess following appendicitis was invariably fatal was so well accepted that when Loison,<sup>118</sup> in 1900, presented a case with recovery, Poirer and Tuffier<sup>118A</sup> questioned the diagnosis. Thompson<sup>119</sup> and Gerster<sup>23</sup> wrote of the hopelessness of the condition. In Petren's<sup>11</sup> series of forty-three cases, the mortality was 93 per cent. Brütt<sup>46</sup> reported a mortality of 95 per cent and Otschkin<sup>51</sup> recently recorded a mortality of 80 per cent. On the other hand, Eliason<sup>14</sup> reports a mortality rate of 50 per cent, but it must be recalled that 58 per cent of his cases had single abscesses. Since all of his cases followed appendicitis, it is difficult to explain the high incidence of single abscesses of the liver in his series. That multiplicity of abscesses in the liver undoubtedly affects the prognosis is clearly demonstrated by the contrasting mortality rates of single and multiple abscesses in our series of cases. Whereas of the twenty-four cases with single abscess of the liver, nine (37.5 per cent) died, of the twenty



cases with multiple abscesses, nineteen (95 per cent) died. (Graph VIII.)

The significance of the presence of

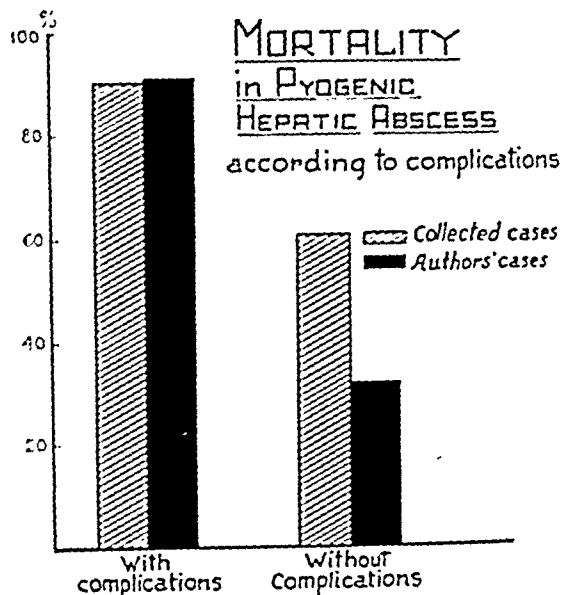


GRAPH VIII. Mortality of pyogenic hepatic abscess according to multiplicity of lesions in 44 of authors' cases.

complications in pyogenic hepatic abscess is clearly revealed in Graph IX. In a collected series of ninety-seven cases of pyogenic liver abscess with complications, the mortality rate was 20.7 per cent, in contrast to a mortality rate of 60.8 per cent in a similar series of 161 cases without complications. This becomes even more pronounced in the authors' series as the mortality rate was 90.9 per cent in twenty-two cases with complications, and 36 per cent in twenty-five cases without complications.

The importance of the type of therapy employed in pyogenic abscess of the liver is emphasized by the results obtained in the authors' series of cases. (Graph X.) In twenty-two cases in which the transabdominal approach was employed for the institution of drainage, there were sixteen deaths (72.7 per cent). The transpleural method of drainage was used in nine cases with six deaths (66.6 per cent). In contrast to these high mortality rates is the 33.3 mortality percentage obtained in six cases in which the extraserous approach was used for the institution of drainage. In previous publications the danger of contamination of an uninvolved pleural or

peritoneal surface has been repeatedly emphasized, as well as detailed descriptions of the type of drainage which avoids



GRAPH IX. Mortality of pyogenic hepatic abscess according to presence or absence of complications in 258 collected and 47 authors' cases.

it.<sup>60,111,120,121,122</sup> Obviously this method of drainage cannot be utilized in all types of pyogenic hepatic abscess.

Pyogenic hepatic abscess in general is accompanied by a very high mortality rate, and, if operation is not employed, is almost invariably fatal. The total mortality rate in a collected series of 432 cases was 79.6 per cent. The total mortality rate in the authors' series of forty-seven cases was 72.3 per cent. Whereas in a collected series of 102 cases not operated upon, the mortality rate was 100 per cent, in a collected series of 151 cases in which operation was performed the mortality rate was 50.9 per cent. These respective mortality rates in the authors' series were 100 per cent and 64.8 per cent. (Graph XI.)

#### COMPLICATIONS

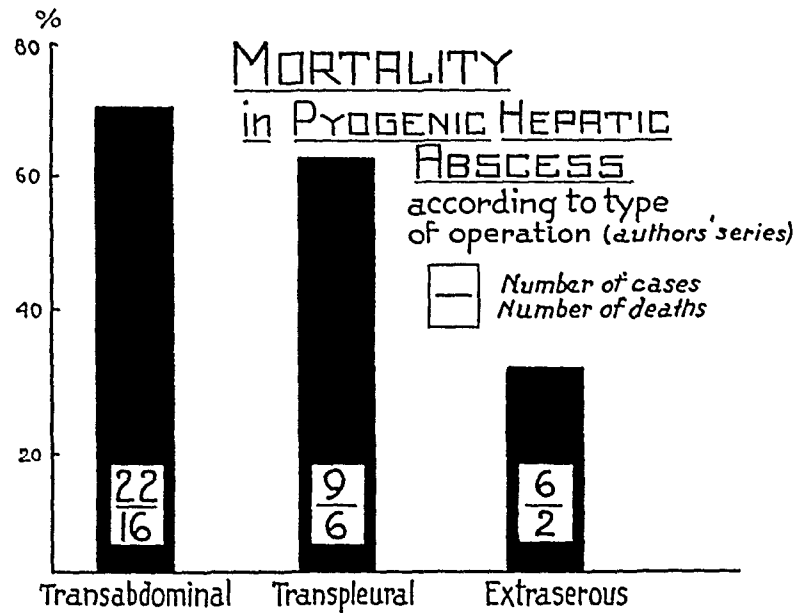
The complications of pyogenic hepatic abscess are usually the result of rupture or direct extension into one of the adjacent viscera or more rarely of thrombosis and embolism and, if present, add considerably to the gravity of the condition. This can be

readily observed from Graph ix. The mortality rates in the collected and in the authors' cases were respectively 60.8 per

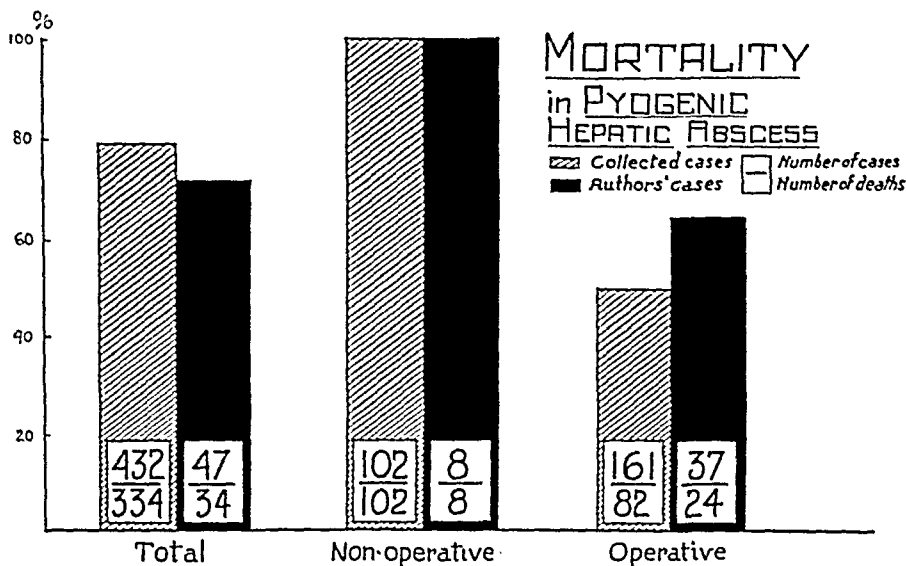
cent and 36 per cent without complications and 90.7 per cent and 90.9 per cent with complications. The most common complication, involvement of the adjacent viscera, is usually indicative of the patient's neglect or procrastination or signifies the physician's unproficiency and inadvertence.

Pleural and pulmonary involvement are undoubtedly the most frequent complications of pyogenic hepatic abscess. In a

possible routes of extension: (1) usually by direct extension through the diaphragm; and (2) rarely by embolism. Except in those cases with pyemia in which abscesses are likely to occur in other organs, pleuropulmonary complications are more commonly associated with single pyogenic abscess of the liver. In such cases the abscess most frequently involves the right lobe of the liver and usually near the dome.



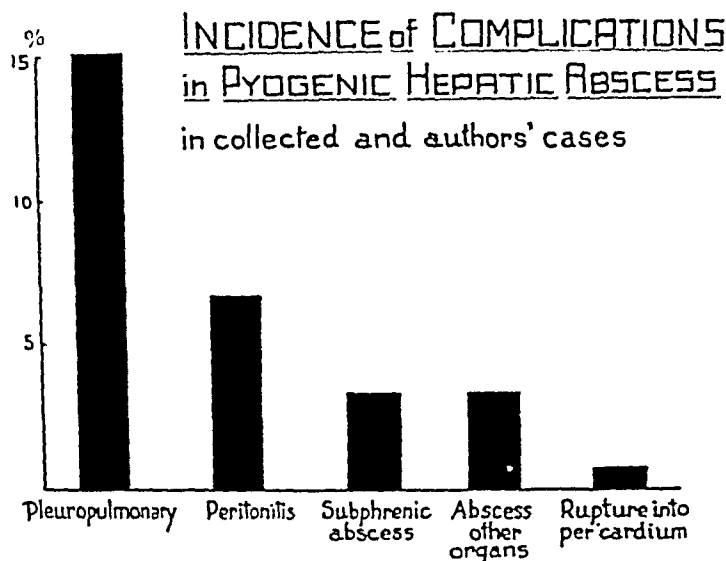
GRAPH X. Comparative mortality rates in 37 of the authors' cases of pyogenic hepatic abscess according to type of operation.



GRAPH XI. Mortality of pyogenic hepatic abscess based upon 432 collected and 47 of the authors' cases.

As the abscess cavity enlarges, the path of least resistance is towards the diaphragm which is gradually incorporated in its wall.

authors' cases, peritonitis was found in thirty-three, an incidence of 7.2 per cent. (Graph XII.) This relatively high incidence



GRAPH XII. Comparative incidence of complications in pyogenic hepatic abscess based upon 453 collected cases including the authors'.

If this process occurs relatively rapidly before an antecedent pleurisy with adhesions develops, the abscess will rupture into the pleural cavity. However, if an accompanying pleurisy with adhesions has previously obliterated the pleural cavity, the abscess ruptures into the base of the right lung. In a collected series of 453 cases, including the authors' cases, pleuropulmonary complications occurred in sixty-nine, an incidence of 15.2 per cent. (Graph XII.) In the authors' series of forty-seven cases there was an associated pneumonia in five (10.6 per cent), lung abscess in four (8.5 per cent), and empyema in two (4.2 per cent).

Peritonitis as a complication of pyogenic liver abscess is a result either of rupture of the abscess into the peritoneal cavity or of contamination by transperitoneal drainage of the abscess. Peritonitis was a complication of liver abscess in seven (8.2 per cent) of eighty-five cases reported by Keefer.<sup>15</sup> There was an associated peritonitis in fourteen (28 per cent) of the fifty cases reported by Collins.<sup>3</sup> In a collected series of 453 cases, including the

of peritonitis was undoubtedly due to the high incidence of transperitoneal drainage (59.4 per cent) and emphasizes the danger of this type of procedure.

Subphrenic abscess as a complication of liver abscess occurs relatively infrequently. Of the 453 collected cases, including those of the authors, this complication was present in eighteen (3.9 per cent). Keefer<sup>15</sup> observed it in five (5.8 per cent) of eighty-five cases. In the authors' forty-seven cases, it occurred in only one (2.1 per cent).

Liver abscess associated with generalized pyemia is likely to be complicated by abscesses in other organs. Under such circumstances, abscesses will be observed in the lungs, kidneys, spleen, and brain. These complications occurred in eighteen (3.9 per cent) of 406 collected cases. These cases are invariably fatal.

More rarely rupture of pyogenic hepatic abscess occurs into the pericardium,<sup>15,124</sup> abdominal wall,<sup>93</sup> vena cava,<sup>125</sup> and thoracic duct.<sup>126</sup> Keefer<sup>15</sup> reported one case with pulmonary infarct. This occurred in one of our cases also.

## TREATMENT

The treatment of pyogenic hepatic abscess may be divided into: (1) prophylactic, and (2) surgical. The importance of prophylaxis cannot be emphasized too greatly. This is particularly applicable to the multiple hepatic abscesses which are preceded by appendicitis and pylephlebitis, because once the development has proceeded to the stage of multiple abscess formation surgical therapy offers only the slightest hope. This becomes obvious upon the realization of the high mortality reported by numerous observers.<sup>11,23 46 51,119</sup> Thus, it is readily apparent that only by the prevention of extension of such a process of inflammation can the mortality rate be materially reduced.

As has been emphasized by Melchior,<sup>127</sup> Thalhimer,<sup>96</sup> and others, it is essential in those cases of appendicitis which give a history of chills occurring pre-operatively that the appendiceal, ileocolic, superior mesenteric vessels, and even the portal vein be examined carefully during the operation. Such an examination will permit the recognition of thrombosis in these vessels, the degree of its extension, and, by the application of proper surgical therapy, the avoidance of the possible development of pylephlebitis and multiple liver abscess. If, during the post-operative course following an appendectomy for acute appendicitis, chills develop and a diagnosis of pylephlebitis can be made, a secondary operation, as suggested by Braun<sup>42</sup> and Melchior,<sup>128</sup> should be performed. Obviously, the earlier the diagnosis is made, the greater likelihood is the procedure to be successful.

Once pylephlebitis has occurred and is recognized either pre-operatively or post-operatively, the treatment is surgical. In 1903, Gerster<sup>23</sup> advocated exposure and evacuation of the infected and thrombosed vein and reported two such successful cases. Wilms,<sup>129</sup> in 1909, advised ligation of the veins at the ileocecal angle and reported a successful case treated in this

manner. On the other hand, Sprengel<sup>130</sup> recorded a case in which this procedure was done and the patient died three weeks later of pylephlebitis and multiple liver abscesses. Reök<sup>48</sup> expressed the view that the Wilms operation is of no avail because the process has usually extended beyond the ileocecal area. In an attempt to obviate this objection, Braun,<sup>42</sup> in 1913, suggested ligation of the ileocolic vein and reported two successful cases in which this procedure was performed. Melchior,<sup>128</sup> in 1928, collected thirteen cases in which the Braun operation had been done and divided them into two groups: (1) primary ligation, i.e., at the time of appendectomy or drainage; and (2) secondary ligation, i.e., after the primary operation. Whereas of the eight cases in the former group none died, only one of the five cases in the latter group lived. Stewart-Wallace<sup>53</sup> recently collected fifteen cases in which primary ligation was performed with recoveries in all but two, and these did not develop pylephlebitis but died of peritonitis.<sup>131</sup> This author<sup>55</sup> reports one case and has collected five others in which the superior mesenteric vein was ligated. Of these six cases, four, including one of his own, recovered. From these observations and his experimental investigations he concludes that it is possible to ligate the superior mesenteric vein at or below the level of the transverse mesocolon and the third part of the duodenum without the development of the bowel necrosis. Because in experimental animals it was possible to obstruct the portal vein completely after producing a collateral circulation, Neuhof<sup>132</sup> suggested that this procedure might be performed in cases of suppurative pylephlebitis. Beer's<sup>133</sup> attempt to do this in a case of pylephlebitis was unsuccessful. Three cases of portal ligation which were unsuccessful were reported by Colp<sup>47</sup> in 1926. It is, therefore, obvious that once the process has extended to the portal vein, ligation of this vessel is of little avail as the affection has already reached the liver. Even in those cases in

which an inflammatory process has extended into the liver and there is evidence of hepatic suppuration, little can be accomplished by surgical intervention except in solitary abscess.

The treatment of solitary pyogenic hepatic abscess consists of incision and drainage. The type of drainage instituted is extremely important, as has been mentioned above. Only that type of drainage which completely avoids the slightest possibility of contamination of a virgin pleural or peritoneal surface should be employed. This surgical principle is an absolute desideratum.

The two types of drainage procedures which can be employed are transthoracic and transabdominal, either through a transserous or an extraserosus approach. The transpleural method of approach was first suggested by Trendelenburg<sup>134</sup> in 1883, for drainage of subphrenic abscess. Avoidance of contamination of the pleural cavity was attempted by suturing the costal and diaphragmatic layers of the pleura together. Beck<sup>135</sup> suggested a modification of this procedure and advocated its performance in two stages: (1) suture of the costophrenic pleural reflection and packing the wound for forty-eight hours with gauze impregnated with an irritative substance to produce adhesions; and (2) incision through this area at a second stage. In a recent publication we<sup>111</sup> have reviewed the literature on this subject and directed attention to the inadequacy of such procedures in protecting the virgin pleural cavity against invasion. This is not only adequately demonstrated but forcefully emphasized by the contrasting mortality rates in the authors' series of cases. Whereas of the nine cases in which the transpleural method of drainage was employed, there were six deaths (66.6 per cent), of the six cases in which the extraserosus approach was used, there were only two deaths (33.3 per cent). (Graph x.)

Similarly, the disadvantages of the transperitoneal approach is apparent in that it permits possible contamination

of the uninvolved portions of the peritoneum. If during laparotomy, pyogenic abscess of the liver is discovered, it is imperative not to drain the abscess at this stage. Adhesions between the peritoneal surface of the liver and the overlying parietal peritoneum should be produced and drainage through this area performed forty-eight hours later. The danger of contaminating the virgin peritoneal cavity is clearly shown in our series of cases. In twenty-two cases in which the transperitoneal method of drainage was instituted, there were sixteen deaths, a mortality rate of 72.7 per cent. (Graph x.)

It therefore becomes obvious that adequate evacuation of liver abscess, particularly solitary abscess, should be performed in such a manner that contamination of the pleural and peritoneal cavities is thoroughly avoided. Depending upon the location, this can be readily accomplished by an extraserosus anterior or posterior approach. If there is evidence of location of the abscess in the anterior or antero-inferior surface of the liver, the procedure advocated by Clairmont<sup>136</sup> for drainage of subphrenic abscess can be utilized. This consists of making the skin incision anteriorly just beneath and parallel to the costal margin and after traversing the oblique muscles and transversalis fascia, carefully mobilizing the parietal peritoneum from the lower surface of the diaphragm. If, following this, the abscess can be reached extraperitoneally, it should be drained at this stage. However, if the abscess cannot be approached extraperitoneally, the visceral and parietal surfaces of the peritoneum should be induced to adhere by packing the area with gauze impregnated with some irritative substance and drainage through this area performed at a subsequent stage.

If there is no evidence of localization of the abscess of the anterior abdominal region, the most rational method of drainage is by the retroperitoneal approach previously described.<sup>111,120,121,122,137,138</sup> This procedure consists briefly of making the

skin incision directly over the twelfth rib and, after subperiosteally resecting this rib, making a transverse incision through its bed at the level of the spinous process of the first lumbar vertebra. Melnikoff<sup>139</sup> has demonstrated by extensive anatomic investigations that the relation of the costophrenic angle to the pleura varies considerably in different individuals, but that it never extends below the level of the spinous process of the first lumbar vertebra. The significance of making the transverse incision at the level of the spinous process of the first lumbar vertebra is, therefore, apparent. After entering through this incision into the retroperitoneal space between the upper pole of the kidney and the inferior surface of the liver, mobilization of the parietal peritoneum from the undersurface of the diaphragm can be readily effected. Thus, the liver abscess can be drained completely extraperitoneally. The results obtained in those cases of the authors' series in which this method of drainage was instituted clearly demonstrate its undeniable usefulness and obvious advantages. Of the six cases in which this method of drainage was employed, only two died, a mortality rate of 33.3 per cent. One of the patients who died was in extremis, with marked jaundice when operated upon, and subsequent examination revealed a huge abscess cavity with the remaining portion of the liver as a mere shell. The other patient developed parotitis and bronchopneumonia post-operatively, and died ten days after operation.

#### SUMMARY

1. An analysis is presented of 830 cases of pyogenic hepatic abscess collected from the world literature and a presentation of 47 additional cases is made.

2. During the ten-year period, 1928–1937 inclusive, there were 186 cases of abscess of the liver admitted to Charity Hospital and Touro Infirmary in New Orleans. Of this number, 139 (74.7 per

cent) were amebic abscesses and 47 (25.2 per cent) were pyogenic. During this same period there were 540,776 total admissions to the Charity Hospital, among which there were 160 (0.029 per cent) abscesses of the liver, and 1,152 patients diagnosed as having liver disease, of which 10.2 per cent were amebic abscesses and 3.6 per cent were pyogenic abscesses. The sex incidence of pyogenic hepatic abscess reveals a preponderance of occurrence in the male, 67.4 per cent in the collected series and 70.2 per cent in the authors'. This is probably explained by the fact that the etiologic agents occur more frequently in the male. The greatest age incidence is from the third to the fifth decades. There is no significant racial predisposition.

3. Pyogenic liver abscess is primarily a complication of an intra-abdominal suppurative process with the antecedent lesions in the portal area. Of these lesions, suppurative appendicitis is the most frequent. Appendicitis was the etiologic agent in 34.2 per cent of the collected cases and 10.6 per cent of the authors' cases. This discrepancy is due to the fact that the majority of reports in the literature represented primarily the author's interest in pylephlebitis and liver abscess as complications of appendicitis. Pyogenic liver abscess can be caused also by direct extension from contiguous suppurative processes, trauma, and by transportation of microorganisms through the hepatic artery from distant foci. There is a relatively large group (59.5 per cent) of the authors' series termed "cryptogenic," idiopathic, or primary pyogenic hepatic abscess in which the antecedent lesion could not be determined.

4. The most frequently found organisms in pyogenic hepatic abscess are *B. coli*, streptococci, and staphylococci.

5. Pyogenic hepatic abscess may be multiple or single, and usually involves the right lobe. The abscesses were single in 28.8 per cent, multiple in 71.1 per cent, and involved the right lobe alone in 41.8 per

cent of the collected cases. In the authors' forty-seven cases these incidences were 54.5 per cent, 45.4 per cent, and 68.1 per cent, respectively.

6. The principal symptoms and signs of pyogenic hepatic abscess are fever, pain and tenderness over the hepatic area, liver enlargement, chills, and jaundice. Characteristically, there is a leucocytosis with a proportionate increase in polymorphonuclear leucocytes. The characteristic roentgenologic changes are elevation and immobility of the diaphragm, usually the right. The diagnosis was positive in 82.1 per cent of 28 cases in the authors' series in which roentgenologic studies were made.

7. The prognosis in pyogenic hepatic abscess depends upon: (1) the multiplicity of the lesions; (2) the presence or absence of complications; and (3) the type of drainage instituted. Whereas of the twenty-four cases in the authors' series with single abscess of the liver nine (37.5 per cent) died, of the twenty cases with multiple abscesses, nineteen (95 per cent) died. The mortality rate was 90.9 per cent in those cases with complications and 36 per cent in the cases without complications. The total mortality rate was 79.6 per cent in the collected cases and 72.3 per cent in the authors' series. Whereas in those cases not operated upon the mortality rate was 100 per cent in both series, in the cases in which operation was performed the mortality was 50.9 per cent in the collected series and 64.8 per cent in the authors' series.

8. The complications of pyogenic hepatic abscess are usually the result of rupture or direct extension into one of the adjacent viscera.

9. The treatment of pyogenic hepatic abscess may be divided into: (1) prophylactic and (2) surgical. Prophylaxis is particularly applicable to multiple hepatic abscesses which are preceded by appendicitis and pyelophlebitis, because once the development has proceeded to the stage of multiple abscess formation, surgical therapy offers only the slightest hope. The

treatment of solitary pyogenic hepatic abscess consists of incision and drainage.

10. The employment of that type of drainage which completely avoids the slightest possibility of contamination of the peritoneal or pleural cavity is of paramount importance. The results obtained in the authors' series of cases clearly demonstrate this fact. Of the twenty-two cases in which the transperitoneal approach was employed for the institution of drainage, there were sixteen deaths (72.7 per cent). The transpleural method of drainage was used in nine cases with six deaths (66.6 per cent). In contrast to these high mortality rates is the 33.3 per cent mortality obtained in six cases in which the extraperitoneal approach was used.

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## BOOK REVIEWS

**ELEMENTS OF ORTHOPAEDIC SURGERY.** By N. Ross Smith, F.R.C.S. (ENG.). Foreword By R. C. Elmslie, F.R.C.S. Baltimore, 1937. William Wood and Company. Price \$4.00.

This work (246 pages) is offered the profession as a concise and practical account of the elements of orthopedic surgery, especially to those members of the profession (surgeons and students) who do not require the full knowledge given by larger textbooks, and for nurses and masseuses engaged in orthopedic work. Rare conditions are omitted or merely mentioned in a few words. Pathologic appearances are stated briefly. The essential steps of operations are indicated, but details needed only by operating surgeons are omitted. In the chapters on fractures mainly the mechanical principles in treatment are considered, so that a sound understanding of the reasons for methods may be readily acquired. In the appendices a short account is given of physiotherapy, splints, appliances, and plaster-of-Paris technique.

There are ninety-nine illustrations and an index.

Naturally, we do not recommend this book to the finished surgeon, but to the medical student and surgical neophyte it is well designed as a prelude to more pretentious texts.

**NEUROLOGY.** By Roy R. Grinker, M.D. Second Edition. Springfield, 1937. Charles C. Thomas. Price \$8.00.

The second edition of Dr. Grinker's "Neurology" continues to maintain the pace set by its predecessor, which was well received by the profession. In its rebirth it has gained rather than lost, as the author has had an opportunity to correct errors and rectify omissions. The title delimits the field accurately, since the scope of the work is sharply restricted to the neurologic field, ignoring psychiatry completely.

This edition follows the well defined path of the first, and in its thirty chapters it covers one thousand pages of fairly compact material. Four hundred well selected illustrations clarify the points and enliven the material.

As stressed by the author, there has been a fairly complete revision of the chapter dealing with the vegetative nervous system, and also that on the cerebral cortex. Likewise in the field of therapy, readers will find the book fairly well up to date. The modern textbook is valueless without appended references, and in this respect one will be gratified to discover full lists. The chapter on the vegetative nervous system cites 83 and that on the cerebral cortex gives 70.

The fundamental purpose of the book is to present a correlated view of neurology, stressing that which each fundamental branch of medicine has to offer, and in this it has not failed. Based on this concept, the clinical presentations are well rounded in their description.

The volume deserves a favorable reception.

**DISEASE AND THE MAN.** By Roger F. Lapham, A.B., M.D. New York, 1937. Oxford University Press. Price \$2.00.

We can write no better a review of Dr. Lapham's book than to quote parts of Dr. H. O. Mosenthal's foreword and say that we, too, agree.

"The successful blending of human relations with science in medicine, that is, the thoughtful application of harsh facts so that patients will not be killed by kindness on the one hand, nor have their sensibilities bruised to a pulp on the other, is persistently coming to the fore as a duty of the physician. Dr. Roger Lapham has succeeded admirably in presenting an instructive, as well as an attractively readable essay on this subject. It is refreshing to realize that one of the younger generation of physicians has had sufficient power of observation and literary energy for the audible formation of his ideas, which should be a help to many. . . . We can, without any reservation, wish that many will read this volume and profit thereby."

The author, in this book of 143 pages, covers the following subjects: The Problem of Medicine, The Physician, Examining the Patient, The Follow-Up, Controlling the Patient, The Neurotic Patient, The Prescription, The Nurse, Physician and Intern, and Conclusion.

A well written, delightful, helpful book.



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R. H. Jackson	Madison
John E. Jennings	Brooklyn
W. L. Keller	Washington, D.C.
H. A. Kelly	Baltimore
T. J. Kirwin	New York
Arthur Krida	New York
A. V. S. Lambert	New York
Maurice Lenx	New York
H. H. M. Lyle	New York
Jerome M. Lynch	New York
Urban Maes	New Orleans
Harrison S. Martland	Newark
Rudolph Matas	New Orleans
Roy D. McClure	Detroit
H. C. Naffziger	San Francisco
C. R. O'Connor	Newark
Louis E. Phaneuf	Boston
Eugene H. Pool	New York
Douglas Quick	New York
N. P. Rathbun	Brooklyn
H. A. Royster	Raleigh
Henry S. Ruth	Philadelphia
A. C. Scott	Temple
M. G. Seelig	St. Louis
J. Bentley Squier	New York
H. J. Stander	New York
George W. Swift	Seattle
H. L. Updegraff	Los Angeles
Grant E. Ward	Baltimore
J. H. Woolsey	San Francisco

## EDITORIALS

### DIGNITY IN MEDICINE

RECENTLY we attended a dinner tendered to a country general practitioner who had completed fifty years of service in medicine. This gentleman, serving a rural community, has lived through the manifold changes in medical practice which have marked the past half century. He has been active both in community and in medical affairs, has served on countless committees and has been elected to the presidency of his county medical society. He has the respect and affection of his medical colleagues, who know that he is a good doctor, a credit to the profession. Outside of his community he is unknown.

His friends and fellow workers, gathered to do him honor, presented him with a gift, and in acknowledging it, he felt called upon "to say a few words,"—words, which among other things, stated something of the credo and philosophy which had governed his life.

"The medical colleges of today," said he, "are graduating men better equipped than those graduated in my time. Hospitals are more numerous; and there is no comparison between the scientific equipment of the hospital of today and the one of fifty years ago—or even with the one of twenty years ago. The intern today is undoubtedly being well trained.

"But medicine has in it today more of the science than of the art. When I began in practice, the young doctor did not have a dollar sign as his goal. He went into medicine because medicine filled his heart, and he felt it was his destiny in life to serve his fellow humans. He believed in the axiom, 'Do good work and the money will look after itself.' In my lifetime I have done more work with the knowledge that I would receive no remuneration for it than work for which I have been paid.

"I, believe in the ethics of our calling. Our ethics call

for no debate. Economic conditions are no excuse for making changes that will allow of a fuller purse. I believe that every physician should acquaint himself with the problems of the profession, and then vote fearlessly and honestly when the time arrives for their consideration.

"I believe wholeheartedly in the American Medical Association. It represents the backbone, heart and brain of our calling. I believe that every self-respecting physician should be a member of his county medical society and that he should be active in that society. He should cooperate in sending well instructed delegates to the meetings of the state society; they in turn can send on proper delegates to the annual meetings of the American Medical Association. He should abide by the final findings and rulings of the parent body. If individual physicians, or groups of physicians, become free lances and break away from the parent organization just because the majority have voted contrary to their beliefs, disaster is around the corner for American medicine.

"Put up your fight in your state and county societies, but, if defeated, abide

by the decisions reached by the majority. Outside groups, groups that go contrary to the decisions reached by the House of Delegates of the American Medical Association, have no part in organized medicine and should be frowned upon.

"I think that today the young man in medicine is concerning himself more with the so-called economic side of his work, especially in his problem of gathering in more and more dollars. He seems to be less concerned in serving his fellows. He is forgetting that medicine is a profession and not a business.

"In my day medicine was a thing of great dignity. I wish that those days could return. In the present day medical schools I would have a part of the curriculum each year devoted to a course of lectures aimed toward the return of dignity to physicians, even though scientific medicine might suffer a bit for the time sacrificed.

"I am glad I have been a physician. I look back on a happy life. It is my honest conviction that medicine is the greatest of all professions."

To all of which we say—"Amen."

T. S. W.

## CONGRATULATIONS AND BEST WISHES

THE W. B. Saunders Company has been celebrating this spring its fiftieth anniversary as a publisher of books for the medical profession. The highlight of the festivities was a dinner in Philadelphia on March 4th, given in honor of Mr. Max Brödel, Associate Professor of Art As Applied to Medicine in the School of Medicine of Johns Hopkins University.

The occasion was a very joyous one, with both the publishing field and the physicians of the country well represented. Mr. R. W. Greene, vice-president of the company, gave the address of welcome. Dr. Thomas S. Cullen acted as toastmaster. Dr. Howard A. Kelly spoke of Max Brödel's contributions to the field of gynecology; Dr. Cullen described the creation of the Department of Art As Applied to Medicine in Johns Hopkins; Dr. Morris Fishbein was at his best in a discussion of Max Brödel's influence on medical illustrating; and Mr. Henry L. Mencken read a very witty essay on Max

Brödel as a pianist. A portrait in oils of Mr. Brödel, painted by Thomas Corner, was presented to Johns Hopkins by Mr. Lawrence Saunders and accepted for the University by its provost, Dr. Edward W. Berry. Mr. Brödel himself gave one of his characteristically modest talks.

It was an occasion which honored not only the recipient, but also the donor. Max Brödel's work is a milestone in medical art, and the Saunders Company has set many a milestone in medical publishing. We, in the name of The American Journal of Surgery, take this opportunity to offer our sincere congratulations to the W. B. Saunders Company, a medical publishing house with a half century of tradition and creditable performance behind it. We hope that in the next fifty years, further prosperity will come, together with a greater opportunity to serve the medical profession of this country and of the world.

T. S. W.

# ORIGINAL ARTICLES

## RENAL RICKETS OR RENAL DWARFISM\*

T. LEON HOWARD, M.D., F.A.C.S.

Associate Professor of Urology, University of Colorado; Genito-Urinary Surgeon, Children's and Mercy Hospitals

DENVER, COLORADO

**R**ENAL rickets and renal dwarfism are names which have been applied to a most interesting, yet little described disease of childhood and early adult life. This disease is manifested by rachitic symptoms, asexualism, renal deficiency, and polyuria. The renal deficiency simulates that of a chronic interstitial nephritis, or nephrosclerosis. Apparently renal rickets has no predominant predilection for one sex.

The paucity of reports of this disease in genitourinary literature, except for a paragraph by Hinman<sup>5</sup> in his recent book, *Principles and Practice of Urology*, prompts us to look to the pediatrician and orthopedist for case reports. According to Pfaundler and Schlossman,<sup>10</sup> it was first recognized by Goodhart in 1872, but A. Graeme Mitchell,<sup>8</sup> of Cincinnati, credits Stenier and Neureutter in 1870 with the first description. In 1883, Lucas<sup>7</sup> described in the *Lancet*, "A Form of Late Rickets associated with Albuminuria." He was of the opinion that albumin occurred too often in rickets of adolescence to be a mere chance finding. Hunt<sup>6</sup> says the average duration of life after the appearance of the bone deformity is less than two years. Up to 1927 there had been but fifty-three recorded cases, and only seven in American literature. The number still remains under 100, but urologists are probably seeing this interesting disease in certain stages of its development, and are failing to recognize it in its entirety because of the multiplicity of symptoms.

For this reason, and because one of the three cases reported here is complete, I am presenting some review of the subject.

While I am fully aware that the disease is not confined strictly to the genitourinary organs, it holds one's interest because of its diversified symptoms and contradictory manifestations. For instance, it is questionable whether, were it not for the renal pathology and blood chemistry, the roentgenologist could differentiate the bone changes from those of ordinary rickets; consequently ordinary dwarfism is often confounded with it.

On account of polyuria and polydypsia, it has been mistaken for diabetes insipidus. Only the terminal stages of renal rickets may show hypertension, arteriosclerosis, signs of uremia, convulsions, edema, failing mentality, and coma. Yet we find every condition which is supposed to enter into the production of these symptoms, namely, a low and fixed urine concentration, high blood protein, low blood calcium with high blood phosphorus, acidosis, and a urine containing albumin with hyaline casts.

I feel certain that there is an acquired type of renal rickets, the cause of which, if not relieved, results in bone changes. Also, there certainly must be a greater number of children suffering from this condition than the few reports in the literature would indicate. The acquired type is often the result of obstructions anywhere below the kidney pelvis. Early cases do not have all the cardinal signs, which are manifest in

\* Read before the Section of Genito-Urinary Surgery, New York Academy of Medicine, Feb. 17, 1937.



the child who has reached the advanced stage of the rachitic; we often prevent the advance to the later stage by relieving the

The face is wrinkled and expressionless, resembling that of a Mongolian idiot. These, together with characteristic leg



FIG. 1. J. S. at the age of 19.

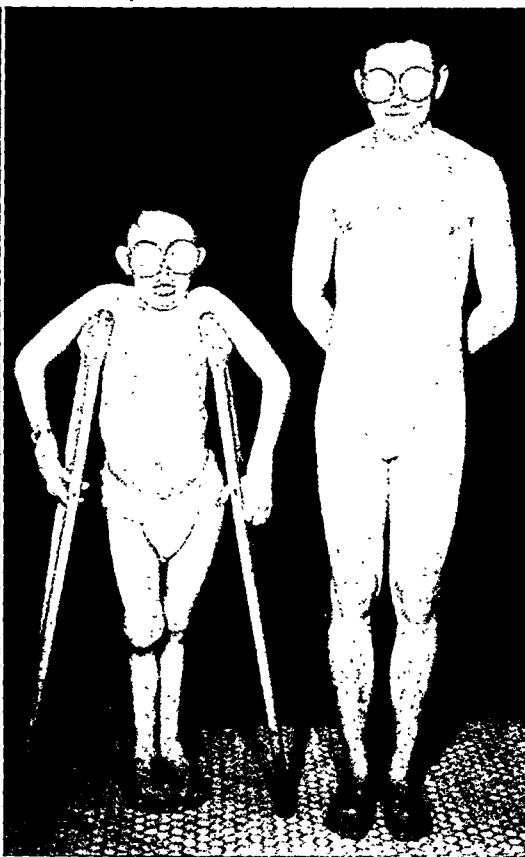


FIG. 2. J. S., compared with a normal boy of the same age.

cause without perhaps realizing that such a disease process was in progress. Mitchell<sup>8</sup> in his most complete review of the literature, mentions congenital dilatation of the urinary passages as a cause, as well as acquired postnatal obstruction. Two of my three cases were secondary to the congenital type of urinary obstruction.

The diagnosis of renal rickets is based on the following findings:

1. *General Appearance.* This usually conforms to a certain type. The skin is dry and often pigmented a dirty yellow. The hair of the head is coarse and brittle, and if the child has reached the age of adolescence, the pubic hair is thin but coarse, with a well defined line of demarcation.

deformities and changes which come with lack of sex development, give a dwarfish appearance. (Figs. 1, 2 and 3.)

2. *Bone Changes.* As a rule these first attract the parents' as well as the physician's attention. The child develops either a genu valgum or a genu varum; confirmation is afforded by the x-ray findings. According to the roentgenologist, the changes are about the epiphyseal areas. There is a greater translucency and a more spongy appearance in the bones of the renal rachitic than in the child with ordinary rickets. The skull picture is characteristic; it has been described by Parson<sup>9</sup> as having a woolly, stippled, or honey-

combed appearance, with great thickness. (Figs. 4, 5 and 6.) I was astounded at the ease with which the skull and the femur

nephritides, we find a molecular retention, and it is well known that the larger the molecule, the quicker and greater will be



FIG. 3. Pubic hair line of J. S. at the age of 19.

were amputated with the ordinary autopsy knife. According to both the roentgenologist, Dr. F. B. Stephenson, and the pathologist, Dr. E. I. Dobos, the skull shows marked thickening, with osteoporosis, and the long bones show faulty calcification (Figs. 7, 8 and 9), with softening at the epiphysis, resulting in the deformities. The sella turcica (Fig. 10) was 6 mm. deep, the minimum for the age, and was 9 mm. in its anteroposterior diameter. This is smaller than the average for the same age, which is 6 by 12 mm. (Fig. 11.)

3. *Blood Changes.* Normal children show a blood calcium of 9 to 11 mg., and phosphorus between 3.5 and 5 mg. per 100 c.c. In renal rickets this ratio changes, the phosphorus *increasing* and the calcium *decreasing*, the opposite of ordinary rickets. The cause of this reversal is one of the much discussed questions of the disease, for, as is well known, there seems to be throughout life a constant attempt to maintain a certain normal balance between the amounts of calcium and phosphorus in the body. In renal rickets, as in all true

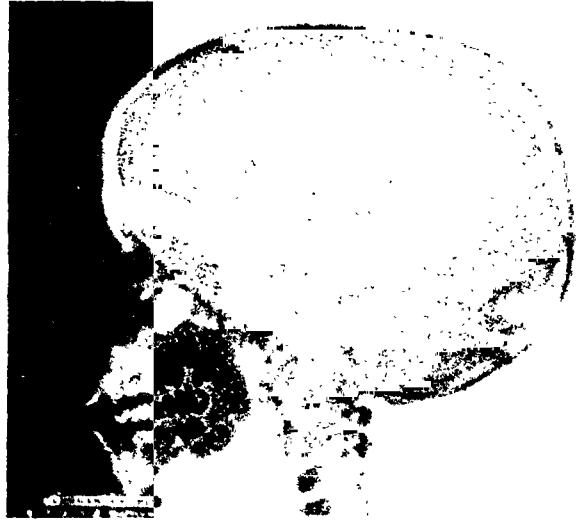


FIG. 4. X-ray of skull, showing woolly appearance.

the retention of the substance which that particular molecule goes to make up.

According to the theory advanced by Mitchell<sup>8</sup> when the kidney begins retaining phosphorus, this substance seeks the bowels as a means of elimination. As it enters the alimentary tract it immediately comes in contact with the food calcium, and, unfortunately for the patient, an insoluble calcium phosphate is formed. This prevents calcium from entering the blood stream, and causes a serious calcium depletion. The necessary calcium must be obtained from some source, and since the exogenous calcium is not available because of its combination with phosphorus for elimination via the colon, bone calcium is drafted for use. The loss of calcium from the bones results in the bone changes so graphically shown in the autopsy findings.

Reports of cases in which bone changes occur have made very little mention of parathyroid findings. Julian D. Boyd,<sup>2</sup> in a report on clinical hyperparathyroidism with the citation of a case, makes the following statement: "It would be easy to make a diagnosis of renal rickets in a patient with bone changes such as are found in this condition, together with such urinary abnormalities. However, the two

conditions can be clearly differentiated by the determination of serum, calcium and phosphorus. In renal rickets, the

to be markedly increased in size (Fig. 12), while at the same time there was an increase of the blood phosphorus to 11.3

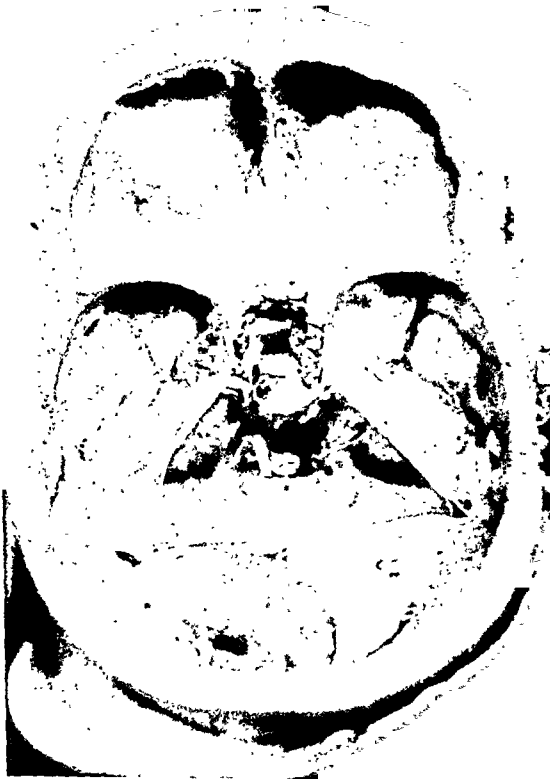


FIG. 5. Photograph of the skull at autopsy, showing the extreme thickness.

calcium is lowered and the phosphorus increased, while in hyperparathyroidism,

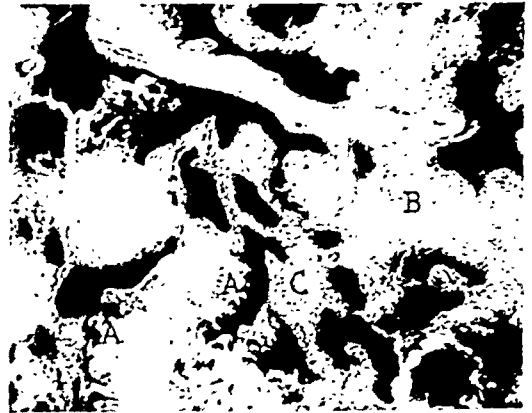


FIG. 6. Photomicrograph from skull, showing bone changes. A, multinucleated osteoclasts in Howship's lacunae. B, fibrous marrow tissue. C, numerous newly formed trabeculae.

mg., with a calcium reading of 9.4 mg. I suspect that all patients of this type, with bone changes, who live any length of time, have an increase in the size of the parathyroids. Where these glands do not show a hyperplasia, there are no bone changes complicating the nephritis; the case should then be classed as one of uncomplicated chronic interstitial nephritis, a condition always ending in an early death. The mere fact that bone changes do occur shows that this type of rickets is due to a hyperplasia

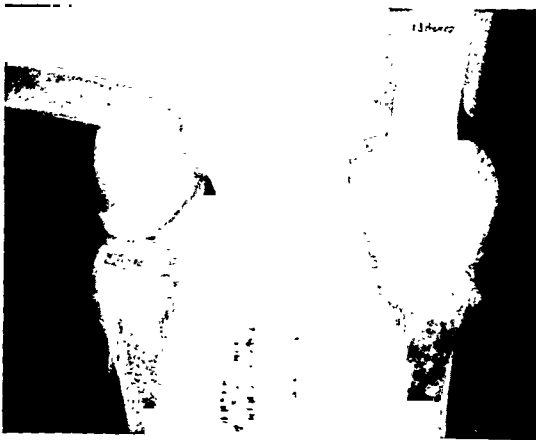


FIG. 7. Bony deformities of the knees.

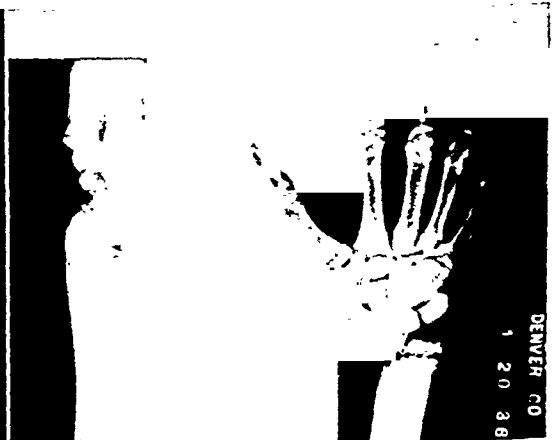


FIG. 8. Deformities of the wrist joint.

the reverse is true." As I have stated, this is a disease of contradictions, for in our reported case the parathyroids are shown

of the parathyroids. (Fig. 13.) It is their hyperactivity which mobilizes the bone calcium, thus in order to maintain keeping

up a sufficient amount of blood serum calcium to prevent, as long as possible, uremic convulsions, which certainly should occur early in the disease, as there is a marked protein retention as well as an acidosis.

Edward L. Compere<sup>3</sup> states: "In the adult as well as in the child, the bone salts are continually removed and renewed, so that there is a constant flow of both calcium and phosphorus away from bone into body fluids, and a redeposition of similar salts which have been absorbed from the intestinal tract. The ratio must be constant if perfect health is to be obtained."

4. *Sex Development.* A lack of sex development at the age of puberty is a characteristic phenomenon in every case. On this account the hormones have been implicated. In this condition, as in other kidney lesions of childhood, lack of sex development is found, but in none of the autopsy protocols of renal rickets have I been able to find reports of sections of either testicles or ovaries, though all writers mention them as undeveloped. Of course, the simplest explanation would be to include the undeveloped sex glands as part of the general picture of dwarfism, but it would be a great deal more plausible were we to ascribe the dwarfism to the inactivity of the sex hormones, in spite of the fact that Hurtz was unable to find any endocrine changes. Figure 14 shows the testicle in our case, and according to the pathologist, there was a total absence of cytogenesis. The lumen of the acini is partially or completely obliterated, and the interstitial cells of Leydig greatly decreased in number. Nevertheless, this patient at the time of his death was twenty years of age. Can the tubular portion of this testicle produce that glamorous hormone (inhibin), the absence of which allows the anterior pituitary lobe free sway? The testicles as a whole appear distinctly smaller than usual, and upon weighing those of our patient, they were found to be only 13.5 Gm. each. The epididymis is essentially negative.

5. *Renal Changes.* It is here that the real diagnosis is made. Up to the present, knowledge of these changes is based only

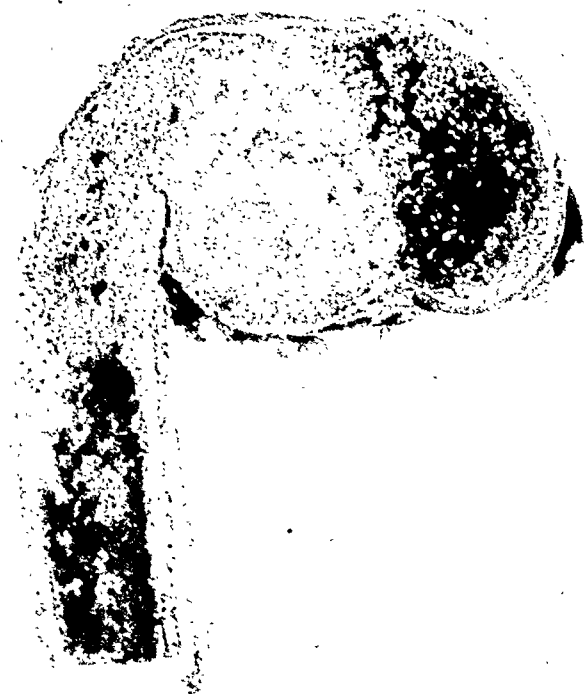


FIG. 9. Autopsy sections through knees, showing faulty calcification with softening at the epiphysis.

on autopsy reports, which in the final analysis are unquestionably the most accurate. Microscopically, there are sclerotic changes in the interstitial tissue, which before death affect the majority of the tubules and glomeruli. Those tubules which are active show a very large lumen due to one of two conditions, a dilatation from back pressure or a compensatory hypertrophy.

Dr. George B. Bader of New York<sup>1</sup> gave an accurate description of these renal changes. The interesting feature about the glomeruli that are left is that they show what appears to be hyperplasia, as though they had made an extra attempt to carry on the work after the interstitial changes had destroyed the majority. Hyalinization has taken place in numerous other glomeruli with lymphoid deposits. Bowman's space in some instances seems as though it had become dilated, making one think that in

its attempt to excrete urine through the tubular system which had become partially blocked by connective tissue, back pressure

with theories. The acquired type is described more often than any other, and yet some authors do not realize that they are



FIG. 10. Sella turcica of J. S. Dimensions 6 by 9 mm.

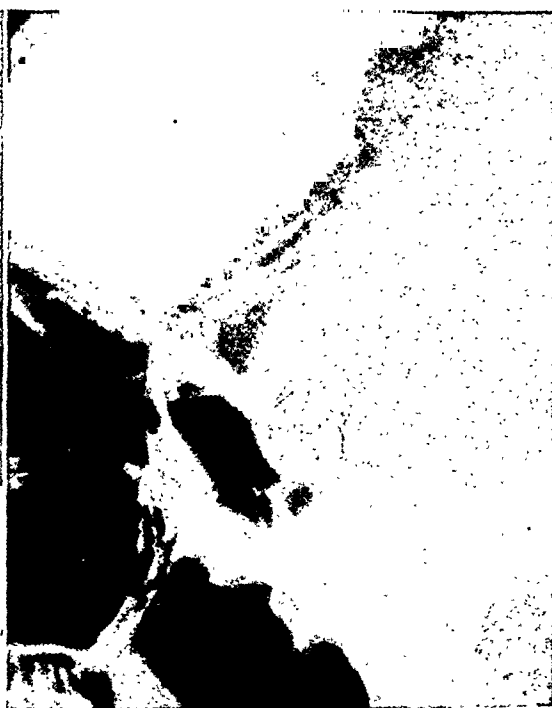


FIG. 11. Normal sella turcica. Dimensions 6 by 12 mm.

had occurred, producing this condition. (Shall we coin a word and call it hydro-bowmanosis?) Something like this must have taken place in many of the glomeruli in which hyalinization followed.

The scarcity of renal blood vessel pathology is of interest and offers the only plausible reason for the low blood-pressure which is so characteristic in these patients. Throughout the entire kidney, calcium is deposited, but it is confined to the interstitial tissue, the tubules escaping and the arteries showing very little change. Again the disease is one of paradoxes, for in other parts of the body the arteries show marked calcium deposits. Several case reports have mentioned renal calculi, but have not designated the location of the stones. (Figs. 15 and 16.)

This type of kidney conceivably is produced by two causes, i.e., either congenital, or acquired. To say what produces the congenital type would be to deal only

dealing with *interstitial* changes in the kidney produced by lower tract pathology. Relief from lower tract pathology by urologic maneuvers is the only hope for these sufferers.

The first case I am reporting is of the congenital type, for which I am indebted to Dr. Roy P. Forbes.<sup>4</sup> The other two patients came under my observation, but it was Dr. Atha Thomas,<sup>11</sup> an orthopedist, to whom I referred one of these patients on account of a genu valgum, who made the diagnosis. In the case of Dr. Forbes, the diagnosis was complete with the exception of the genitourinary findings, and later, the autopsy report. I was requested to see the patient to examine the renal tract. The following case history was obtained from the records of the Children's Hospital, where the patient had been under observation at varying intervals for the preceding four years.

## CASE REPORT

J. S., age 16 years, was seen in September 1933, with a diagnosis of renal rickets.

His father was 6 feet tall, and weighed 225 pounds. His mother, brothers, and sisters were of average size. There had been no miscarriages, and there was no history of lues in father or mother; no history of any chronic familial diseases.

The patient was a full term baby, delivered normally, with a weight of 6 pounds at birth. He had been breast fed until one year of age. Beginning at six months, orange juice  $\frac{1}{2}$  to 1 ounce daily and lime water were given. Shortly afterward, egg, cereal, and green vegetables were added. At one year, Eagle Brand milk was given, but no cod liver oil was taken until two years of age. The patient lived on a farm in Missouri, and had abundant exposure to sunshine. However, from a birth weight of 6 pounds, he gained only 6 additional pounds in two years. *The skin has always had a bronze color.* His first tooth erupted at six months. The fontanelle closed at the age of one year, according to his mother. She noticed no bony changes in skull or ribs, but the lower legs were bowed, due to softness of bones (*genu varum*). The patient began walking at  $1\frac{1}{2}$  years, but owing to extreme bowing of legs, wore braces for support. Later, he developed knock-knees (*genu valgum*). He began school at the age of 6, but his mother considered him backward in comparison with other children, and at the age of 15, he finally reached the eighth grade. He was out of school at the age of 6 because of a fracture of the right leg (cause of this fracture was not given). Diseases and injuries include scarlet fever at 5, with no follow-up urinalysis; compound fracture of right tibia at age of 6, which became infected and bone was scraped one year later; only recently a small amount of drainage recurred; appendectomy at 14.

*Present Illness.* Mother presented the child at Children's Hospital on the advice of the physician who had treated the old infection of the leg. The chief complaint was that the child had failed to grow and develop normally, that his bones were soft, necessitating braces for support. There was no history of growing pains. The symptoms reported were moderate frequency and polyuria; moderate polydipsia; no headaches; occasional vomiting and distention relieved by fruit juices and soda water; no con-

vulsions; no tetany; slight edema of the ankles at times; no hemorrhage tendency; no visual disturbance; no palpitation.



FIG. 12. Autopsy specimen of parathyroids, greatly enlarged.

*Physical Examination.* The patient was a poorly nourished, poorly developed white male, apparently about 12 years of age, though his real age was 16, lying quietly in bed with no apparent distress. His voice was of a childlike quality. His skin was loose, dry, and of a sallow, dirty, bronzed appearance. The scalp was clean, with a normal growth of brown hair, coarse in texture. The skull was symmetrical, but the prominent *parietal* bones made it appear large in relation to the rest of the body. His facial expression was vacant, and his features definitely mongoloid. The ears were negative. The pupils reacted normally, with normal fundi and muscle balance. There was no obstruction to breathing, and the buccal mucous membrane was normal. The teeth, small in size, were stained a dirty yellow. The tonsils were somewhat enlarged, giving evidence

of chronic inflammation, but no adenopathy was present. The patient was markedly pigeon-chested. No Harrison groove was noted; the

Blood chemistry showed N. P. N. 109 mg. per cent; creatinine 4 mg.; phosphorus 6 mg.; calcium 10.5 mg.

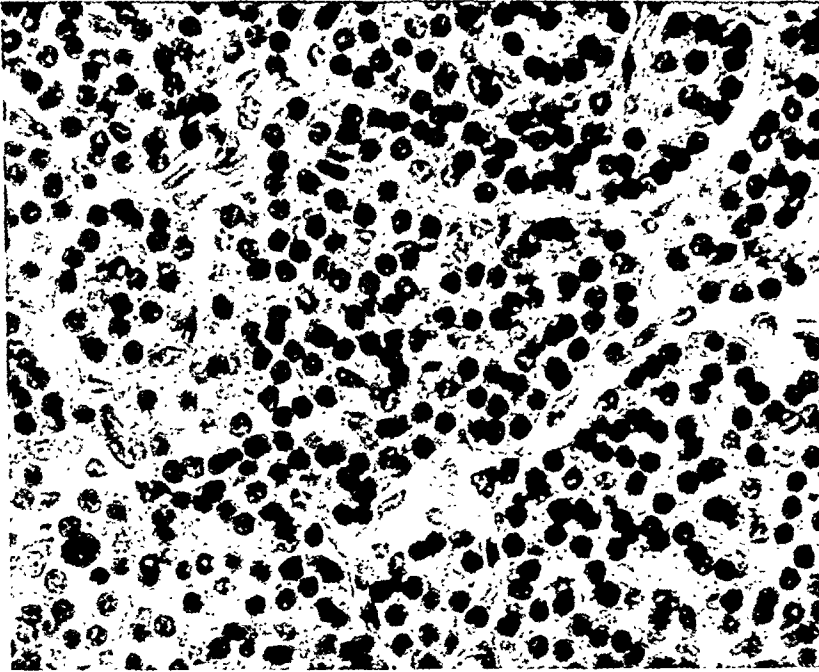


FIG. 13. Photomicrograph of parathyroid, showing marked hyperplasia.

percussion note was resonant, and the breath sounds clear. No apparent enlargement of the heart was noted, and the sounds were of good quality. A tendency to pot belly with slight distention was present, but no tenderness was elicited and no organs were palpable. No scoliosis or kyphosis was observed.

The extremities were poorly developed, the joints prominent, but without tenderness. There was a marked exterior bowing of both femurs, most pronounced in lower third, with mild genu valgum and marked genu recurvatum, subluxation of both knee joints, and valgus deformity of both ankles. The genitalia were small in size; no pubic or axillary hair was present. The reflexes were within normal limits.

**Laboratory Findings.** The urine was acid, with a specific gravity of 1.003, a trace of albumin. Sugar and acetone were absent; no casts were noted; there were few white cells and no red cells. The Mosenthal kidney function test showed fixation to 1.004 and 1.007. The blood hemoglobin was 45 per cent; R. B. C., 2,250,000; W. B. C. 6,400; 62 per cent polymorphonuclears; 38 per cent lymphocytes.

The basal metabolic rate was plus 3 per cent.

The blood Wasserman was negative.

**Psychological Examination.** I. Q. was 55 on the Binet test and 60 on the Otis.

**Roentgenologic Examination.** X-ray of skull showed the sella turcica to be slightly smaller than normal for a child of this age. Tibia and fibula showed some cupping of the lower epiphysis of each leg, having the appearance of an old rachitic condition. Some irregularity of outline appeared at the lower epiphysis of each ulna and radius, with some cupping, suggestive of rachitic change. In November 1933, x-rays of the hands showed slightly increased recalcification of the lower epiphysis of the ulna and radius, representing a slight improvement over last examination.

In June 1934, a second laboratory examination disclosed that the urine was neutral, with a specific gravity of 1.006; albumin 2 plus; sugar and acetone negative. An occasional pus cell was present. The blood hemoglobin was 50 per cent; R. B. C. 3,000,000; W. B. C. 6,600; 67 per cent polymorphonuclears; 31 per cent lymphocytes; 2 per cent eosinophiles.

Blood chemistry at this time gave the following results: N. P. N. 120 mg.; creatinine 12 mg.; calcium 9.4 mg.; phosphorus 11.3 mg.

(Certainly a most interesting blood chemistry, in the face of the improved blood counts.)

On August 1935 the urine was acid, with a

In January 1936, the child was brought to the hospital because of recently occurring distention with vomiting. This had occurred



FIG. 14. Photomicrographs of sections through the testicular tubule, showing a total absence of cytogenesis.

specific gravity of 1.014, albumin 1 plus, and an occasional pus cell. Blood chemistry showed N. P. N. 100 mg.; creatinine 5.2 mg.; urea 45.0 mg.; calcium 9.0 mg.; phosphorus 7.0 mg.

sometimes after meals, but was relieved by either fruit juices or soda water. Between meals, distention was also induced by cold water. Physical examination showed no essen-



tial change from the previous records. Blood chemistry was as follows: N. P. N. 110 mg.; creatinine 3.65 mg.; calcium 6.9 mg.; phos-

On March 3, 1936, the  $\text{CO}_2$  combining power of the blood plasma was 32. A complete eye examination was negative in every respect.

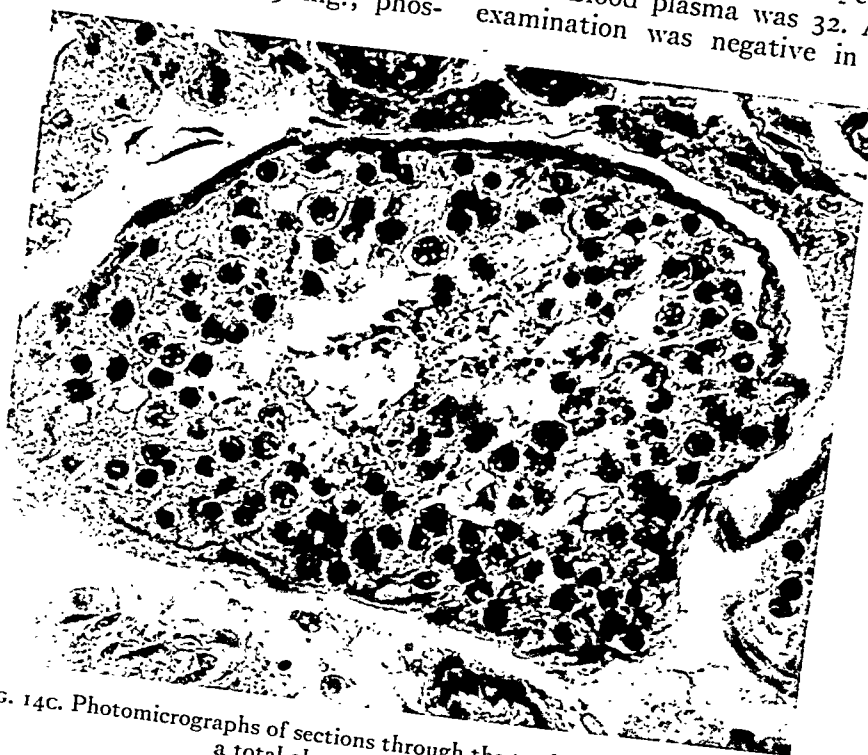


FIG. 14c. Photomicrographs of sections through the testicular tubule, showing a total absence of cytogenesis.

phorus 8.3 mg. The Mosenthal fixation test showed improvement, varying between 1.008 and 1.014.

The blood count was: hemoglobin 36 per cent; R. B. C. 2,500,000; W. B. C. 4,000; 65 per cent polymorphonuclears; 35 per cent. (Fig. 17.)

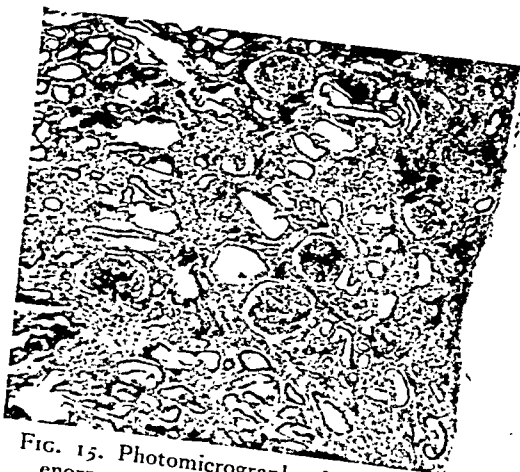


FIG. 15. Photomicrograph of kidneys, showing enormous dilatation of the tubular system with an increase in the size of the individual glomeruli.

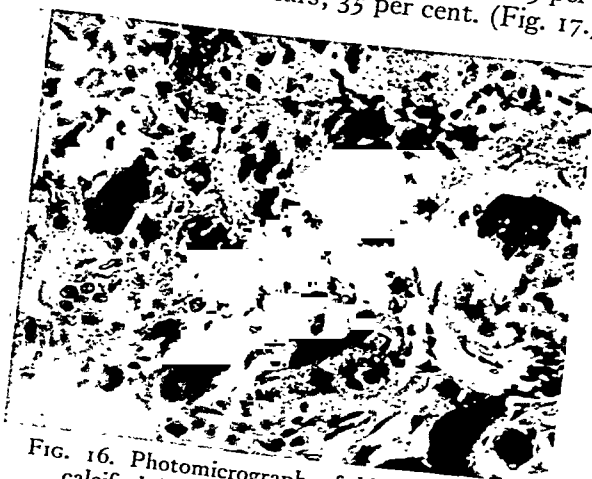


FIG. 16. Photomicrograph of kidney, showing calcified deposits in the interstitial tissue.

On February 28, 1936, the blood chemistry was: N. P. N. 172 mg.; urea nitrogen 53.2 mg.; creatinine 4.6 mg.; calcium 10.6 mg.; phosphorus 8.8 mg.; per 100 c.c. of blood.

Course. I was called in consultation to see this patient January 26, 1936, at which time cystoscopy was done. A No. 21 F. Brown-culty under a local anesthetic. The bladder was most interesting on inspection, as it gave one

the impression of a toneless sac. The mucosa was extremely pale. The ureteral openings were not dilated, but the orifice on the right was

defect except that it was of miniature size, with but two well-defined major calices present. There was no deformity of the major calices,

	N.F.N.	Urea	Creatinin	Calcium	Phosphorus
Sept. '33	109	-	4.0	10.5	6.0
June '34	120	-	12.0	9.4	11.3
Aug. '35	58.5	-	2.7	8.7	7.0
Dec. '35	100	45	5.2	9.0	7.0
Jan. '36	100	-	3.6	6.9	8.3
Feb. '36	172	53.2	4.6	10.6	8.8

Mosenthal Fixation Sept. '33 1004 to 1007

Jan. '36 1008 to 1014

CO<sub>2</sub> Combining Power of Blood Plasma  
March '36 32

FIG. 17. A few of the blood and urine findings in the case of J. S. from September 1933 to February 1936.

larger than normal. No. 5 radiographic catheters were introduced up to each kidney, the right meeting with obstruction about 2.5 cm. up, although the meatus on that side was the larger. After some manipulation, the obstruction was overcome and no further difficulty was encountered. Urines were collected from each side, urine from the left coming with more frequent and forceful drops than from the right.

Stereo-retrograde pyelograms were made, using neoipax as shadow media. (Fig. 18.) The dimensions of these kidneys are measured on the films as follows: right, 8 cm. in length, 3 cm. in width; left, 7 cm. in length, 2.5 cm. in width. (Fig. 18A.) Compare these dimensions with those of a 6 months old infant, whose kidney measures 6 cm. in length and 3 cm. in width. (Fig. 19.)

Figure 20 is a cystogram made by using a 3.5 per cent solution of sodium iodide and filling the bladder until a sensation of fullness was complained of. This occurred after the introduction of 14 ounces of the solution. There is no regurgitation up either ureter.

From a urologic standpoint, it is inconceivable that kidneys of this size are capable of carrying on life at all in a person even half the patient's size. The only classification under which they can conceivably be placed would be that of congenital hypoplastic kidneys, for they appeared to be perfectly developed in shape, position and contour. The one on the right had no major calices, the minor calices springing directly from the kidney pelvis, as so often occurs in a hypoplasia of the kidney of congenital origin. The pelvis on the left showed no



FIG. 18A. Pyelogram taken January 26, 1936.

yet it was apparent that they were not nearly so well developed as those of the 6 months old baby demonstrated.

The ureter on the right showed some dilatation, which was probably accounted for by the obstruction in the first 2.5 cm. of the ureter. (Fig. 21.) The urines collected from each kidney gave the same findings as the combined urines, except for an occasional pus cell from the left. There was only an occasional urine report which gave an acid reaction; yet the blood showed that the patient was in a state of acidosis.

The prostate felt by rectum, had two well-defined lateral lobes with a median sulcus, and to the examining finger there was diminished elasticity. A vigorous massage given to both vesicles and prostate failed to express the slightest secretion. The massage was done on a full bladder, filled with distilled water which was sent to the laboratory after it was voided. No spermatazoa or amylaceous bodies were found—in fact to the eye, the water was as clear as when introduced into the bladder. The scrotum was of the flabby type, seen often in old men, with very sluggish cremasteric reflexes. Both testicles were firm, but small and round, like those of a child of 3 to 4 years. I was able to define the epididymis, and there seemed

to be a slight amount of fluctuation on the head of the one on the right. The vasa were plainly palpable.

plete cystoscopic examination, and certainly the only one in which the seminal vesicles have been x-rayed.

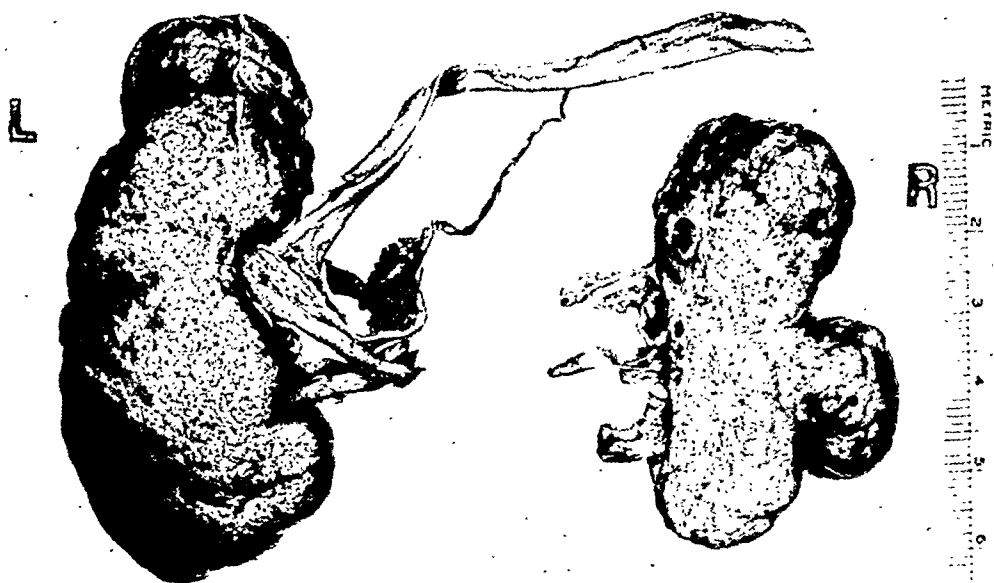


FIG. 18B. Autopsy of kidney, September 10, 1936.

On February 27, 1936, another cystoscopy was performed, for I was curious to see with a McCarthy panendoscope, the appearance of the prostatic urethra, and to reinspect the bladder. There were no notable changes in the bladder from the previous examination, but the ureters were very close to the bladder sphincter, which I find is usually the case when a patient has, as this one did, a well-defined collar neck obstruction, although no residual urine was demonstrable at either examination. The verumontanum was large and extremely pale; the openings of both ejaculatory ducts was easily visualized.

On March 2, 1936, I catheterized the left ejaculatory duct and injected 3 c.c. of neoipax to see if atrophy of the seminal vesicles had occurred along with that of the testicles. The vesicle could be well filled, and the vas could be followed down to the external inguinal ring (Fig. 22), which proves that a failure of development of the testicle does not necessarily produce an atrophy of the vas and seminal vesicles.

As far as I am able to find, this is the only case of renal rickets that has ever had a com-

An intravenous dye of neoipax, using 15 c.c., was given, and at the end of thirty minutes nothing had been excreted in sufficient quantity to give the shadow of either kidney, pelvis, ureter, or bladder. Figure 23 was taken during this period to demonstrate this, and brought out a most interesting finding, namely, calcification of the internal iliac arteries on both sides. This calcification has been mentioned by several writers on the subject, but always as an autopsy finding. To me it is hard to explain why there should be calcification in these arteries and decalcification in the bones. One would think that with the blood so deficient in calcium, the substance would be drawn from any source possible; yet these arteries have every appearance of deposits of calcium salts in their walls. This was later checked at the autopsy. The changes in the bony pelvis (Fig. 23) are also typical of those of renal rickets.

The adrenals may play a more important rôle than has hitherto been ascribed to them. Dr. Dobos describes a fatty infiltration of the cortex, with the medullary substance essentially negative. (Fig. 24.) As the cortex is the principal secretory portion of the gland, this

fatty change could interfere with the physiologic function, even to the extent of causing the pigmentation in the skin.

last two days his fingers became cyanotic and the heart tones poor. Despite stimulation, he expired September 10, 1936.



FIG. 19. Pyelogram of a 6 months old infant. Compare this with that of the 19 year old patient.

This patient entered the hospital (walked in) for the last time on August 6, 1936, and the following is taken from the hospital record:

"This patient, who has been in the hospital repeatedly over a four-year period, entered because of vomiting. He had not been able to retain fluids for twenty-four hours. A blood examination revealed: N. P. N. 300 mg.; creatinine 4.9 mg.; calcium 9 mg.; phosphorus 10.2 mg.; chlorides 412; with a blood pH of 6.95. Physical examination was apparently the same as on previous examinations, except that the deformities were more marked."

The patient did well for about two days. He then developed a severe stomatitis. The nasal cavity and tongue looked as if they were covered with a leukoplakia. The blood-pressure remained about 110/40. The eyegrounds were normal. The patient refused feedings, and vomited continuously. Intravenous fluids, Hartman's and glucose, and a blood transfusion were given. The patient then complained of inability to move his left arm and leg, but no paralysis or weakness was noted on physical examination. The course was steadily downhill. The young man became mentally torpid. The



FIG. 20. Cystogram of J. S., using 3.5 sodium iodide.

Figure 25 shows other blood examinations during this last illness. On several occasions the specific gravity of the urine was between 1.012 and 1.018, which seems incredible when one considers the kidney drainage. The vomiting, however, could account for this concentration.

**Autopsy.** The autopsy findings were recorded by the pathologist, Dr. E. I. Dobos, who also prepared the material from which the illustrations were made.

#### Autopsy Protocol

Name: J. S.	Case No. 22439
Age: 19 years	Autopsy held at Children's
Attending Physician: Dr. R. Forbes	Hospital, September 10, 1936.
Prosector: Dr. E. I. Dobos	Present at Autopsy: Drs. Forbes, Howard, McGraw, Verploeg, and House Staff.

The body is that of a poorly developed and very poorly nourished white male child 135 cm. in length. The head appears to be enlarged and out of proportion to the rest of the body. The skin shows marked brownish color which appears to be fairly generalized. However, there are numerous areas of varying size where the skin appears to be bleached. The general

appearance of the skin closely resembles the bronze color of Addison's disease. The subcutaneous tissue has lost the greatest portion



FIG. 21. X-ray of right kidney, showing no major calices.

of the fat content, and the skin may be lifted up in extremely thin folds. The skeletal changes are extensive. There is a marked deformity of the spine which appears to be a kyphoscoliosis, with possibly a lordotic curve in the thoracic region. The bony wall of the chest shows a marked lateral compression on both sides causing a prominence of the sternum—thus somewhat approximating the shape of a pigeon chest. At the junction of the osseous and cartilaginous portion of the ribs on both sides, prominent swelling is noted on all ribs. The comparative measurements are: anteroposterior diameter of the bone portion of the ribs, 7 mm.; anteroposterior diameter of the cartilaginous portion of the ribs, 6 mm.; anteroposterior diameter at the osteochondral junction, 16 mm. The pelvic frame appears to be usual in configuration. Upon examination of the lower extremities, a marked genu valgum is noted.

Upon opening the chest, approximately 40 c.c. of straw-colored, clear fluid is encountered on both sides of the pleural cavities. A few firm, callous adhesions are encountered on both sides of the pleural cavity. Otherwise, the pleural surfaces are essentially negative. The lung parenchyma is rusty brownish in

color, shows no areas of consolidation or atelectasis, and on the cut surface a considerable amount of straw-colored, clear fluid empties on pressure from the alveolar spaces. The pericardial sac contains the usual amount of straw-colored, clear fluid. The heart is moderately enlarged, and the enlargement is chiefly due to dilatation rather than hypertrophy. The measurements of the myocardium are: left ventricular myocardium, 11 mm.; right ventricular myocardium, 3.5 mm. The myocardium is soft and flabby throughout and appears grayish in color. Examination of the mural and valvular endocardium fails to disclose significant anatomic changes. Upon examination of the large vessels, several disseminated atheromatous plaques are found just above the sinus of Valsalva which entirely disappears in the ascending portion and in the arch of the aorta. No atheromatous changes are found in the pulmonary artery or in the coronary vessels. The structures of the posterior mediastinum are essentially negative. The peribronchial and hilus lymphnodes show no evidence of enlargement and are usual in shape, color, and consistency. The thymus has almost completely disappeared. Upon removal of the upper respiratory passages, the entire larynx is dissected and removed. It shows no significant gross anatomic changes. The thyroid gland is somewhat asymmetric. The left lobe measures 40 mm. in length and 18 mm. in the anteroposterior diameter. The right lobe measures 46 mm. in length and 17 mm. in the anteroposterior diameter. The isthmus is broad. On the posterior aspect of the thyroid gland, two tumor masses are found on the left side, and one attached to the right lobe of the thyroid gland. All those tumor masses are in the anatomic location which corresponds with the usual site of the parathyroid glands. These tumor masses appear as encapsulated prominent structures attached to, but apparently independent of, the thyroid gland, and differing from the substance of the thyroid in color and consistency. The upper nodule attached to the left lobe is more globular in shape and measures 11 mm. in diameter, while the tumors attached to the lower pole of the thyroid gland, one on each side, are more elliptical in shape, measuring 15 mm. in length and 9 mm. in thickness. The weight of these nodules is estimated as follows (I feel sure this estimate is too low): left upper nodule, .67 Gm.; left lower nodule, 1.02 Gm.; right nodule, .74 Gm.

The gastrointestinal tract is removed, opened, and examined, but outside of a moderate injection of the lower part of the ileum and

essentially negative. Both adrenals appear to be greatly enlarged, weighing 14 Gm. each. The spermatic cord, epididymis, and testes are



FIG. 22. Injection of the left seminal vesicle and left vas, showing normality of both.



FIG. 23. Calcification of the internal iliac arteries on both sides. Note also the pelvic bone changes.

of the cecum, no noteworthy changes are encountered. The spleen is moderately enlarged. The capsule is smooth and glistening, and on cross section reveals a preponderance of connective tissue; very little scraping is obtainable. The weight is 119 Gm. The liver is usual in size, shape, and appearance, and on cross section shows no noteworthy changes. The pancreas is somewhat smaller than usual, is firm and hard in consistency, but no other changes are observed. Upon the removal of the kidneys, both are found to be considerably smaller than usual. The left kidney weighs 38 Gm. and the right kidney 22 Gm. The capsule is stripped off easily and underneath the capsule the cortical surface is finely granular in appearance and contains numerous small cysts containing straw-colored, clear fluid. The average diameter of these cysts is 2 mm. On cross section, several small calcareous masses are encountered. The entire kidney substance is profoundly fibrosed, and the markings have almost entirely disappeared. The pyramids are not recognizable, and the boundaries between the medullary substance and cortex are indistinct. The calices and kidney pelves are

removed. The testes appear distinctly smaller than usual, weighing 13.5 Gm. each.

Examination of the thoracic and abdominal aorta discloses small atheromatous plaques around the orifices of the intercostal arteries. At the bifurcation of the iliac arteries, numerous atheromatous ulcerations and calcareous deposits are found. Gross examination of the skeletal bones reveals a generalized softening which attains such a degree that all bones, with the exception of the shafts of the long bones, can be easily cut with a knife. Such changes are particularly pronounced in the vertebrae, in the epiphyseal ends of the long bones, and in the cranial vault. The frontal bone in the midline between the two orbital spaces measures 12.5 mm. in diameter, and its consistency is such that it can easily be cut with a razor blade. The flat bones, the epiphyseal ends of the long bones, as well as the shafts, show a large amount of fat accumulation, which is indicated by the yellowish discoloration of these areas. The distal end of the femur shows such softening of the bony structure that the axis of the epiphyseal end forms a 90 degree angle with the

axis of the shaft. On cross section, it appears that the metaphyseal disc is enormously thickened, attaining a thickness of 39 mm.;

*Microscopic Examination.* Bone. Examination of the skeletal bones shows extensive fibrous tissue replacement of the bony struc-

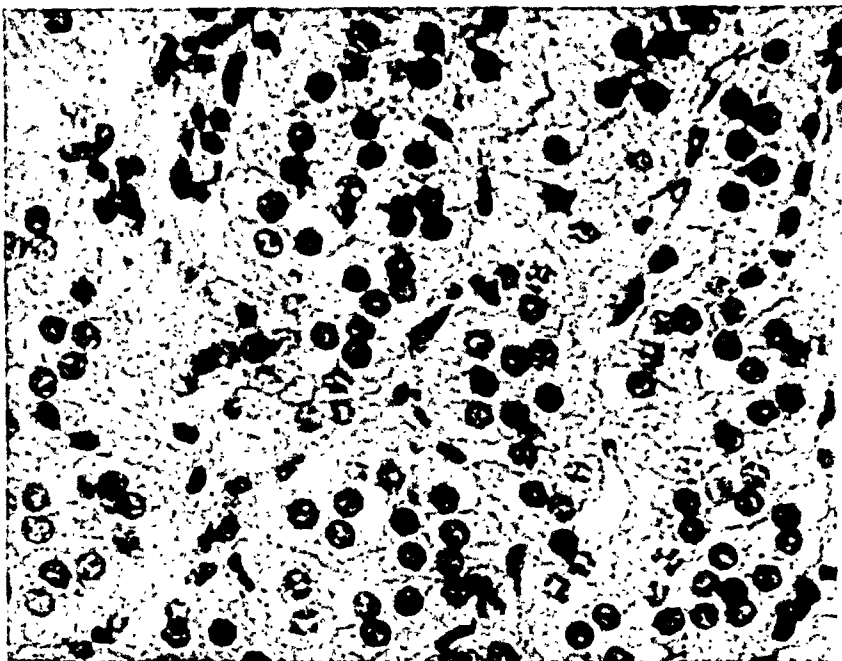


FIG. 24. Photomicrograph of the suprarenal gland, showing marked fatty degeneration.

and in contrast to the fatty infiltration of the epiphysis and diaphysis, this metaphyseal disc is composed almost entirely of hyalinous cartilage tissue through which narrow strands of bony tissue are woven through. The articulation surfaces and synovial membrane appear

tures. In the fibrous tissue, there are disseminated areas where osteoblasts are present, indicating some degree of new bone formation, while the bone trabeculae show extensive fragmentation and depletion of calcium. It should be emphasized, however, that no evidence of excessive numbers of osteoblasts is found in any place in the sectioned area. Besides the connective tissue, large amounts of adipose tissue deposits are found, especially in the epiphyseal ends of the long bones, as well as in the medullary canal. The metaphysis is composed chiefly of hyalinous cartilage tissue containing small bone trabeculae. The periosteum shows a diffuse fibrous thickening.

Kidneys. Throughout the entire kidney substance, medullary as well as cortical, profound connective tissue proliferation is encountered. There are several areas of various sizes where the connective tissue undergoes calcareous changes; there are definite evidences of calcareous deposits in some of the larger vessels, and calcium deposits in the interstitial stroma. The glomeruli show asphyxiation, and part of the uriniferous tubes are compressed and obliterated, while others are greatly distended,

	Aug. 26	Aug. 31	Sept. 2
N.P.N.	300.0	300.0	300.0
Greatinin	4.9	6.1	--
Calcium	9.0	--	--
Phosphorus	10.2	6.95	--
Chloride	--	412.5	--

FIG. 25. Blood findings in the case of J. S. a few days before death.

to be as usual. Bone changes similar to those described in the femur are observed in the other long bones.

Upon opening the cranial vault, the brain and meninges are exposed. Upon the removal of those organs, no significant anatomic changes are encountered. The pituitary gland is somewhat smaller than usual. It weighs 0.4 Gm.

attaining a diameter many times the usual size. In the vicinity of the surface, the cortical substance shows numerous foci of round cell infil-

and toward the center portion the cellular structure becomes more confluent. The intercellular stroma is rather insignificant throughout the



FIG. 26. J. M. (Case 11). Ureteropyelogram, showing catheters coiled in dilated ureters, with a large hydronephrosis of the left kidney pelvis.



FIG. 27. Cystogram of same patient, showing a regurgitation of the dye to each kidney.

tration, which occasionally are perivascular, while in other places disseminated in the interstitial stroma, there are marked degenerative changes in the tubular epithelium.

**Coronary Artery.** Extensive atheromatous and calcareous changes are found in the second layer of the intima, accompanied by ulcerations in the first layer.

**Testes.** While the apparatus of spermatogenesis is well developed, no evidences of actual cytogenesis can be observed. The lumina of most of the acini are partially or completely obliterated, and the Leydig interstitial cells are greatly decreased in number. The epididymis is essentially negative.

**Thyroid Gland.** The acini are unusually large and are filled with excessive colloid material. The interstitial stroma is scant, and the blood supply is usual. The glandular epithelium is single layer cuboid epithelium.

**Parathyroids.** Microscopic examination of the parathyroid reveals dense cellular structure of lobular arrangement. The lobules vary in size considerably and are separated from each other by narrow strands of connective tissue fibers. This lobular arrangement is more pronounced on the peripheral portion of the gland,

entire sectioned area. Among the cells, it was noted that the eosinophile cells are strikingly few in number. However, close examination reveals slight eosinophile character in a fairly large number of the cells, but inasmuch as the morphologic character does not comply with that of the usual eosinophile cells of the parathyroid, they cannot be considered as such. The cells are uniform in shape, size and appearance and show no evidence of adenomatous or malignant changes. The diagnosis is hyperplasia of the parathyroids.

**Adrenal.** The adrenal cortex shows considerable fatty infiltration especially of the glomerular and the fascicular layers. At the junction of the medullary and cortical substances, several round cell deposits are observed. The medullary substance is essentially negative.

**Myocardium.** The myocardium shows no fragmentation of the muscle fibers, but there is a marked enlargement and thickening of the sarcoplasm. The striation is also disturbed.

**Pancreas.** Essentially negative.

I wish to reiterate that, in my opinion, this case represents the congenital type of rickets, for every indication points to the



fact that practically from birth, this child had all the criteria that go to make up renal rickets or renal dwarfism.

one year previously, but no other illnesses. There was no disturbance of gait; the child had been able to run up and down stairs



FIG. 28. J. M. Regurgitation to the right kidney after a suprapubic drainage.

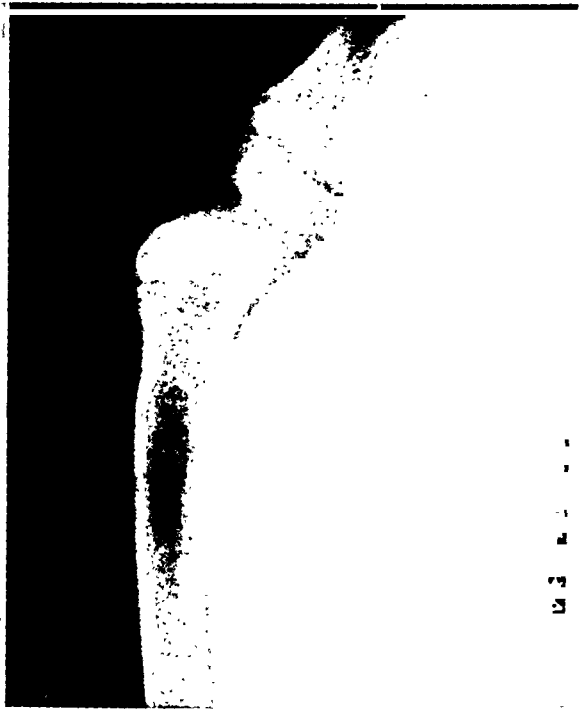


FIG. 29. X-ray of left knee in same patient, demonstrating early epiphyseal deformity.

**CASE II.** The next case is one of the acquired type of renal rickets, and the history leads one to believe the causes for the bone changes were of longer standing than the subsequent findings would indicate.

#### CASE HISTORY

J. M., age 11 years, male, of Saratoga, Wyoming was first seen in my office on August 20, 1931. His family history was negative, except that the mother had a right renal calculus. One sister is living and well, and one brother was born prematurely.

**Past History.** The mother stated that since the age of two, the patient had had trouble in voiding, and at times would roll in agony on the floor while attempting to urinate. As long as she could remember, the urine had contained pus and had had a foul odor. At the age of four, the boy developed a right inguinal hernia, for which he was operated on, and strange to say, the operation held despite the fact that he had to strain with each voiding. He had had measles

without difficulty, played and fished with other boys his age. He was in the sixth grade at school and very bright. His greatest weight had been one year before (65 pounds). He had always been constipated.

**Present Illness.** The patient had come in because of increasing difficulty in voiding, and persistent pus in the urine. He had no nocturia, but upon arising in the morning, passed large quantities of urine with difficulty. He had never complained of pain over either kidney. On August 21, 1931, at Mercy Hospital, a cystoscopic examination was done under gas, using a No. 12 cystoscope. The bladder neck was definitely constricted, inelastic, and fibrous in character. The bladder itself showed cellulitis and each ureteral opening was gaping widely, typical of a congenital bladder neck obstruction in which the valves of each ureteral opening had been destroyed from back pressure. A No. 4 catheter was passed up to each ureter. Figure 26 shows the catheters curled in the lower ureters; the injection of uroselectan failed to give a satisfactory picture of the pelves of the kidneys because most of it

regurgitated into the bladder. Urine collected from each kidney contained only an occasional pus cell. The voided bladder urine had a specific gravity of 1.009, was acid in reaction, had a trace of albumin, but no sugar, acetone, or casts. There were many pus cells and many red cells.

Blood chemistry showed N.P.N. 90 mg.; urea 50 mg.; creatinine 3.7 mg. sugar 100 mg., per 100 c.c. No blood phosphorus or calcium determinations were done.

The patient left the hospital the following day, but was readmitted sixteen days later. In the meantime, the blood chemistry had improved: N.P.N. was 50 mg.; urea nitrogen 30 mg.; creatinine 2.3 mg., per 100 c.c. Blood examination was as follows: white and red corpuscles were normal, hemoglobin was 75 per cent, and coagulation time two minutes.

The P. S. P. excretion was 33 per cent at the end of one hour, which I think is quite interesting when one considers the amount of destruction the kidneys have undergone, as shown in plates of ten days previously; yet we were unable to obtain a pyelogram with uroselectan intravenously. The patient was placed on a urethral catheter drainage which improved the kidney function still further, and on account of this improvement, I advised a bladder neck resection. The parents objected, however.

The patient left the hospital October 18, 1931, only to return six days later with a temperature of 103, the first that he had had. Blood chemistry was again bad. P. S. P. excretion at the end of the first half-hour was 3 per cent, and for the hour 10 per cent. A cystogram, taken on November 9, 1931, is shown in Figure 27. This demonstrates the regurgitation of the dye up the ureters. This x-ray plate also gives a very excellent picture of the pelvic bones, and the heads of the femurs, which according to the roentgenologist show no rachitic changes.

On November 13, 1931, the bladder was opened suprapubically and the fibrous neck was resected. The impression on palpating the bladder sphincter was that of an unyielding metal band. The punch, when cutting through it, made a sound as though it was of a cartilaginous material. The wound was closed around a Pezzar catheter, but the suprapubic opening had to be kept for constant drainage up to the time of the patient's death in the summer of 1936. Although when the tube was

clamped off, his urinary stream was good, and he emptied his bladder, if this persisted for a few days, he would develop toxic symptoms.

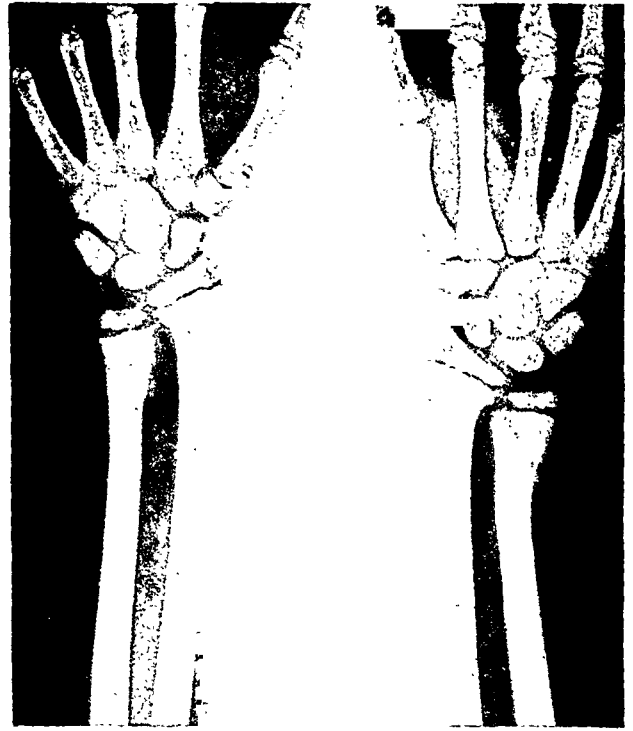


FIG. 30. J. M. Changes in the bones of both wrists around the epiphyseal areas.

I judge that the mere act of voiding forced urine up the ureters into the kidney pelvis, for the ureterovesical valves never recovered their tone, as we demonstrated many times. (Fig. 28.)

Following this operation, his general condition improved, and on December 2, 1931, he left the hospital for his Wyoming home.

On August 3, 1933, a year and seven months after his operation, the patient was brought to the office by his mother, who stated he was having considerable distress on account of pains around the right knee joint, and because of this walking was painful as well as difficult. He was referred to one of the pediatricians for diagnosis, but the cause of the joint pain was not determined.

In June of 1934, almost a year later, the mother returned with him, stating that the condition had grown rapidly worse and he was walking with great difficulty. As has already been stated, he was seen by Dr. Atha Thomas, the orthopedist on service at the Children's Hospital, but it was not until November 18, 1934, that a definite diagnosis of renal rickets, based on the blood calcium and phosphorus findings, together with x-ray pictures of the

long bones, was made. The blood chemistry at this time was as follows: N.P.N. 108 mg.; creatinine 3.3 mg.; calcium 10.3 mg.; phos-

phorus 6.3 mg., and the calcium showed no decrease from normal limits.

I feel confident that if the proper diagnosis



FIG. 31. B. W. (Case 111). Regurgitation of cystographic media to left kidney. 1926.



FIG. 32. Cystogram of 1936, showing no regurgitation following resection in 1931.

phorus 6.3 mg. The blood count was: Hemoglobin 80 per cent; R.B.C. 4,480,000; W.B.C. 11,700. Urinalysis developed a specific gravity of 1.005; albumin 1 plus; an occasional leucocyte present; occasional red blood cells;

of bladder neck obstruction had been made at the time of the hernia operation, and the obstruction had been relieved then, the patient would not have developed ten years later the rachitic symptoms and renal failure that slowly



FIG. 33. B. W. Uretero-pyelogram made in 1930.

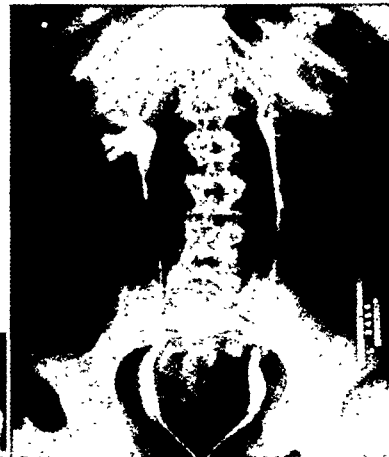


FIG. 34. Uretero-pyelogram of same patient. 1936.

streptococci on culture. The bone changes are shown in Figures 9 and 30.

*Remarks.* Were it not for the bony changes in this patient, as discovered in 1934, it is questionable whether the blood chemistry alone would have given sufficient evidence to classify this case as one of renal rickets. Yet it might have been suspected although the phosphorus

followed. Even in the face of the fact that his renal condition was grave in 1931, the roentgenologist did not suspect any rachitic changes. It is unfortunate that this child's symptoms were masked by the straining through of a hernia in attempts to void, and that the hernia was considered his major problem instead of the bladder neck obstruction, though the

mother was certain that the urine contained pus and was of a foul odor previous to and during this hernial hospitalization.

This patient died at his home in the summer of 1936, and I have been unable to obtain a final history.

CASE III. The third patient B. W., age 16, still reports at the office, and is at the present time in excellent health. He plays basketball, is on his debating team in school, and his only defects are a slight genu valgum of the left knee and a lack of sex development. His condition is unquestionably due to a bladder neck obstruction, which was partially relieved by an open operation six years ago. The illustrations show pyelograms and cystograms, extending from 1926 to the present time. There is still evident renal pathology, but the regurgitation of the left ureter no longer exists, although the kidney outlines indicate that both are below normal in size. One may note the straight spinal column in the early pictures before the genu valgum occurred, and the one of December 1936 (Fig. 34), showing the compensating scoliosis following the genu valgum of the left knee. Roentgen pictures of the knee show no bone changes.

Before this patient came under my care, the diagnosis was that of a neurologic bladder and urethra. He still does not quite empty his bladder, and I contemplate the removal of more tissue from the bladder neck.

I feel confident that this case would have followed the other two had not his bladder neck obstruction been removed. As previously mentioned, he has one deformed leg, lack of testicular development with the other changes that go along with this hormonal deficiency, namely, no facial hair, sallow complexion, and childlike voice.

#### SUMMARY

1. Renal rickets is a disease of early adult life and is secondary to either unexplainable congenital defects or obstructive lower urinary tract pathology.

2. An early and correct diagnosis of the obstructive pathology with correction will prevent in many patients a fatal termination.

3. Patients who develop bone changes must show a hyperplasia of the parathyroids.

4. It is very necessary that a more accurate knowledge of renal pathology in its relation to hyperparathyroidism be sought, and vice versa.

5. Those patients who develop hypertension and edema early will never reach the rachitic stage and should be classed as interstitial nephritics.

6. In those cases of continuing low blood pressure the renal arteries show no changes.

7. There still remains no satisfactory explanation as to the lack of gonadal development.

I wish to acknowledge the splendid work done by Mr. Glenn E. Mills of the Photographic Department of the University of Colorado in preparing the plates for this paper.

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#### DISCUSSION

DR. CLYDE LEROY DEMING: Our conception of rickets is complicated by a mass of new ideas, for I was brought up in medicine when there was little known about avitaminosis rickets, except a bowing of the tibiae, a few humps on the wrists and ankles, the rachitic rosary, and so forth. And now we have handed to us rickets of the kidney.

My first conception of rickets of the kidney was a bowing of the ureter and some dysfunc-

tion of the kidney. Perhaps I have been rather backward in accepting the diagnosis of renal rickets. My conceptions of renal rickets have been further retarded by the lack of opportunity to see the cases. This is probably true also of my friends in the audience, because most of these cases have been viewed by the pediatricians and it is only recently that the pediatrician has felt that he could not get along without the urologist. I feel indebted to Dr. Howard for being one of the first urologists to bring this subject before our Society and our specialty. He has given us a clean-cut picture of the disease in children, which is characterized first by renal deficiency, usually by a urine with a low specific gravity and alkaline in reaction or near the neutral point, a high non-protein nitrogen, a blood chemistry picture of lowered calcium and increased phosphorus, and an x-ray picture which is characteristic of hyperparathyroidism.

Before some of these problems are cleared up we must know more about the x-ray picture in hyperparathyroidism; we must know more about osteomalacia, cystic disease of the bone, the epiphysis in syphilis and Paget's disease.

Dr. Howard has attempted for the first time to classify these cases of renal rickets. I have never attempted to classify them. I do not know who has, and I honor him in his attempt. We have only had five cases at the New Haven Hospital. In trying to classify them in the same manner as Dr. Howard, I find I can say that two belong to the congenital type without dilatation of the ureters or any evidence of obstruction. Two cases had obstruction, one at the bladder neck and the other at the lower ends of the ureters. The fifth case was a puzzle. It presented all of the usual bone pictures which have been demonstrated. The urinary picture was compatible, the non-protein nitrogen was high; but the blood chemistry was normal.

There have been a few reports of cases which showed a normal calcium and a very slight, if any, elevation of the blood phosphorus. That brought to my mind the question as to whether or not there were any phases of this disease during which there was an attempt at recovery and a "speed-up" of certain processes. In reviewing this fifth case of ours, we found that the skull plate, instead of being woolly in type, or a granular skull, as our radiologist wished to explain this film, there were certain areas which looked as though there had been an attempt to deposit calcium. Some of these patients at times

have a return to almost normal blood calcium and very little elevation of blood phosphorus. Dr. Howard has shown that one of his cases demonstrated this change. These changes in the blood picture and in the x-ray may signify regressions in the disease. Whether this conception is true or not, it is a problem for us to consider.

With regard to the definite etiology of renal rickets, there are several reports by Parsons, Pappenheimer and Wilens, who have shown that a long-standing nephritis may be the underlying factor. A low blood calcium and a high phosphorus usually develop in a case with interstitial nephritis of long standing, or in a case with congenital nephritis. Dr. Howard, as well as other writers, has stated that in an interstitial nephritis case the phosphorus may not be put out through the urine, but goes into the intestine and unites with the calcium, making an unabsorbable compound, with the result that there is a depletion of calcium. Where there is a long depletion of calcium, there is probably a stimulation of the parathyroid producing a hyperplasia of the parathyroid as a compensatory reaction. We then get those changes in calcium metabolism which are shown in the x-ray films.

Let us look at the opposite side of the calcium metabolism picture. Take, if you will, a hyperparathyroid case and allow it to exist over a long period of time. The patient will develop a nephritis. Both diseases produce changes in the calcium metabolism with practically the same x-ray bone pictures, but the blood chemistry for calcium and phosphorus is reversed.

Why do we have in this disease a complication of hypogonadism? I am particularly interested in hypogonadism. I believe that the thymus, the thyroid, and the pituitary play a big part in it. That brings in the question whether or not this picture of renal rickets is not still more complicated than we appreciate. A low blood pressure depends much on the thyroid and the adrenal. May we not, just for the sake of arguing, inject possibly the thyroid and adrenal into this picture? The fatty infiltration of the adrenal which has been shown us may be positive evidence of multi-hormonal involvement.

But I am not content to explain this picture wholly on the basis of renal insufficiency of congenital origin or on a hormonal basis. The acquired type which has been discussed seems acquired only to a certain degree. Why should

we blame an obstruction of the urinary tract for renal rickets when we see renal rickets without urinary obstruction? Why do not our prostatic cases, which have an obstruction over a long period of time, develop similar changes in the blood picture and in the gonads? If we rely on the kidney alone, why do not polycystic kidney cases develop more changes in the blood pictures? These have a long-standing nephritis.

I believe that we must take one step further back. We have seen injured cord cases develop a hydro-ureter and a hydronephrosis without obstruction. Here there is an injury to the sympathetic and parasympathetic nerves. Harvey Cushing has stated in his book on the pituitary that lesions of the pars intermedia and pars posterior produce a hydro-ureter and hydronephrosis without any evidence of obstruction in the urinary tract. These are associated with hypogonadism, low blood pressure, and so forth. I would like to suggest that perhaps these cases of renal rickets are not due simply to a congenital malformation of the kidney, but to a congenital malformation of the diencephalon.

The prognosis in these cases is bad, according to all the literature of the pediatricians. I commend Dr. Howard for bringing before us tonight the fact that he has brought a case of so-called renal rickets through a period of obstruction up to the age of 16. This patient is in better health than any of the cases I have seen or read about.

DR. EDWIN BEER: The only adequate excuse I can offer for entering the discussion of this interesting group of cases is to be found in the fact that the first paper I wrote was devoted to a closely related subject—metastatic lime deposits—as well as to the fact that some twenty-two years ago I published a study of a series of cases similar to the acquired group referred to by Dr. Howard, and have seen well over fifty such cases, many of which are described in our monograph on “Diseases of the Urinary Tract in Children.”

After reading carefully the paper of the evening, I cannot convince myself that Case 1 was anything else than a case of infantile rickets, and that following the attack of scarlet fever at five years the patient developed an interstitial and fatal nephritis. MacCallum, thirty-two years ago, called attention to the association of renal diseases and parathyroid enlargement which seems to have been present in this case,

though in the autopsy notes no mention of the microscopic picture, whether hyperplasia or adenomata, was made. The inability of the badly diseased kidneys to excrete allows of accumulation of phosphoric acid ions, which may act on the calcium in the bone and as compensation for this upset in the calcium metabolism, possibly the parathyroids become enlarged and hyperplastic. In Case 1 the disease of the bones seems to have begun before the child was 2 years old, so that I cannot agree with Dr. Howard's conclusion that this was a disease of early adult life.

In Cases II and III, the disease also started in early life, in one surely at 2 years. These cases correspond with the cases that I have been studying for almost thirty years. They seem to be cases of dysharmony between the detrusor and sphincter muscles of the bladder, and regularly develop fibrosis with contracture of the bladder neck. The pathology at the neck leads to back pressure effects, hypertrophy of the bladder—giving way of the ureter meati and usually bilateral dilatation of the ureters and kidney pelves with atrophy of the parenchyma. When infection develops, they usually come to the urologist. In the large series of cases that I have studied, most of the children are undersized, poorly nourished and pale. They might be classified in some instances as infantile or dwarfed, but as far as I can recall, none showed evidence of rickets. In those cases of contracture of the neck, associated with bone changes, perhaps the parathyroids and poor renal function are again producing the picture.

Alfred Hess says; “It is possible that the effect on the metaphysis is due largely to the fact that the nephritis occurs at a time when the bones are in the stage of active growth.” It is of great interest to note that Ellis and Evans collected in the London Hospital twenty cases in as many years belonging to the group associated with contractures of the neck, though they seem to have failed to recognize this pathology. Under “Renal Dwarfism,” they describe the same clinical picture of obstruction at the bladder neck, and in fourteen out of seventeen autopsies in this series they found “varying degrees of dilatation, which in some cases was extreme.” Moreover, they state that “the urinary retention appeared to occur at the level of the urethrovesical sphincter. No obvious cause of the obstruction or lesion of the nervous system was found. A disorder of the neuromuscular mechanism control-

ling the urethrovesical sphincter is suggested." Unfortunately the case histories and the autopsy reports are so briefly given that they are of little value in elucidating our problems, and still more unfortunate, the post-mortem examinations seemed to have regularly avoided the parathyroids, which surely are an important factor in the secondary bone changes, as has been again emphasized by Shelling and Remsen in a recent publication of a case belonging in this same group of contractures of the bladder. In this case all four parathyroids were hyperplastic and very large.

From these few words it can be readily seen that we are still rather in the dark concerning what is called renal rickets, and we all are indebted to Dr. Howard for reminding us of this still obscure clinical picture, so that as opportunities offer, we can delve a little deeper into this borderline group of patients and help in their elucidation.

DR. MEREDITH F. CAMPBELL: Concerning so-called renal rickets, so irregular are the pathologic and clinical manifestations, as well as the laboratory findings, notably the blood calcium and plasma phosphorus estimations, that terminology alone is a matter of no small moment. Park and Elliot in Brennemann's recent "Pediatrics" discuss at considerable length why the designation renal rickets, renal infantilism, renal dwarfism, and so forth should be replaced by that of renal hyperparathyroidism with osteoporosis (osteitis) fibrosa cystica.

The problem of so-called renal rickets interests me greatly because we have here a serious condition which conceivably may be prevented by early recognition of the usual basic etiologic factors, viz., obstruction. The condition is but another which illustrates and emphasizes the importance of a thorough urologic examination in children when proper indication exists. Chronic pyuria is often present and in the cases which are not diagnosed as, and interminably treated for "chronic pyelitis," the diagnosis of chronic interstitial nephritis is made. The clinical and laboratory picture of chronic interstitial nephritis is so often produced by advanced urinary obstruction affecting the total renal secretory apparatus that it is my feeling, and I am sure it is Dr. Lyttle's also, that patients in whom this diagnosis is made should at least be subjected to an excretory urographic study. When the renal function is low and intravenous uro-

graphy is therefore of no aid, the urethral and/or ureteral catheter may advisedly be employed, in many cases together with cystography and retrograde pyelography. In a few children in this group in whom Dr. Lyttle and I were mutually interested, only a thorough urologic examination disclosed the obstruction and urostatic nature of the basic pathology of the "chronic interstitial nephritis."

Moreover, it is likely that urologists fail to recognize many of these cases of renal rickets; I think I have correctly observed five cases, but am sure many more went unrecognized. Three of these cases were seen with Dr. Lyttle and doubtless he will discuss them; they came to autopsy. In a 7 year old boy with renal rickets, congenital bilateral renal hypoplasia existed. Post-mortem, diminutive kidneys were found with a ureter coming from the anterior surface of each organ. In another boy of 4½ years, but 2 years in size, advanced bilateral hydronephrosis resulted from bilateral ureterovesical junction stricture; there is secondary ureteropelvic angulation obstruction. This boy appeared and acted like a little old man; he was bow-legged, wizened, looked worried, and there was beginning baldness of the anterior third of the scalp. The non-protein nitrogen was 65 mg. per 100 c.c. of blood. Bilateral nephrostomy was performed and the boy was returned to his home. Marked general as well as renal improvement has occurred and we hope eventually to relieve the obstruction on each side.

What appears to be a genuine case of renal rickets was studied at Bellevue Hospital in June, 1936. A 7-year old boy weighing only 26½ pounds was admitted with a diagnosis of congenital nephritis. He had been treated at other hospital dispensaries in the past. He had never been well, never gained, was constipated, cachectic, and had a brown tint to his skin. This curious skin pigmentation has been noted in several of the reported cases of renal rickets. The breath was offensive; the lower ribs flared with some beading; the mentality was below average, and a sero-sanguinous anal discharge existed. The blood pressure ranged between 136/98 and 164/112 mm. Hg. There was a mild leucopenia; the red cell count varied between 1,200,000 and 1,700,000, with 49 per cent hemoglobin despite three transfusions. The phenolsulfonphthalein test showed no dye was excreted. The non-protein nitrogen was 197 mg., 208 mg. and creatinine

7.3 mg. per 100 c.c. of blood. The urine showed albumin 2 plus, occasional white and red blood cells. Notably, the serum calcium (diminished) was 5.4 mg. and the plasma phosphorus was 13 mg. (increased). The  $\text{CO}_2$  estimation was 26.7 volumes per cent. Intravenous urogram showed no excretion. The cystogram was normal (no reflux or residuum). X-ray of the long bones showed no rachitic changes; the upper end of the right humerus showed changes of osteochondritis juvenalis deformans. The treatment employed was three transfusions; saline and 5 per cent glucose; high caloric diet; 5 c.c. of 10 per cent calcium gluconate was given intravenously daily for four days. The patient died of renal failure three weeks after admission. No autopsy was obtained; we had withheld retrograde pyelography under the erroneous impression autopsy permission was obtainable. This boy, we believe, had true renal hyperparathyroidism; certainly the low blood calcium and high plasma phosphorus suggest this.

DR. JOHN D. LITTLE: I think everybody agrees that renal rickets, renal dwarfism, and renal infantilism, are not good terms for this disease. Rickets is not an obligatory part of the picture; its presence depends entirely on the bone age. If growth is complete, bone changes may occur without dwarfism being present, so that is not necessary; and infantilism has been present in only a few of the cases on record. The term used by Park and Elliot, and advocated by Albright and his co-workers, describes the pathology and the clinical picture. It is renal hyperparathyroidism with osteoporosis (osteitis) fibrosa cystica.

A study of the pathology gives the key to pathogenesis; the primary condition is renal insufficiency, which can be brought about in more than one way. In some of the cases reported there is a definite renal hypoplasia. In the first case we studied at the Babies' Hospital, the kidneys of an 11-year old boy weighed 20 Gm., the normal weight for a newborn infant. In addition, the kidneys showed cystic degeneration and fibrosis.

Urinary tract obstruction and infection, if they persist long enough, lead to renal insufficiency. The obstruction can be due to a neurogenic bladder, or any one of the urological conditions which give rise to vesical outlet obstruction. Infection usually develops, which leads to destruction of the kidney and to fibrosis or nephrosclerosis. Edema, retinitis and

hypertension are not commonly found in these children.

The second thing to consider in the pathology is the parathyroid glands. I should like to ask Dr. Howard about the histopathology of the enlarged parathyroid glands in the case he showed. I take it the enlargement was simple hyperplasia, and not an adenoma, as is common in primary hyperparathyroidism.

The third pathologic change of course is in the bones. In a very young child, where endochondral growth is going on, rickets of variable severity will be found. In an older child there will probably be moderate changes in the endochondrium and knock-knees or bow-legs are present, and in a still older patient, where endochondral growth is complete, little or no deformity is seen. Anatomically, the changes are at times rickets, but the essential finding is osteoporosis such as we see in hyperparathyroidism. That hyperparathyroidism is a direct result of renal insufficiency seems likely. I believe that experimental work and clinical investigation will prove that definitely. Dr. Pappenheimer and Dr. Wilens and others have found that in patients dying of chronic Bright's disease there is from 100 to 200 per cent increase in parathyroid weight as compared to a control series. These workers have reduced the kidney tissue in animals, and have demonstrated hyperparathyroid glands at autopsy. Work recently published by Hamilton and Highman indicates that in individuals who have advanced renal disease, hyperparathyroidism is present, as shown by the Hamilton and Schwartz test. It is not known how this renal insufficiency induces hyperparathyroidism, or what produces the demineralization which goes on in this disease. Park believes that in renal insufficiency phosphate retention results in low serum calcium. This altered calcium-phosphorus equilibrium the parathyroid glands attempt to overcome and they become hypertrophied. The bone changes are a result of the overactivity of the parathyroid glands. Identical changes in the bones are seen in primary hyperparathyroidism and following experimental injection of parathyroid extract in animals. But the mechanism by which these bone changes are brought about is still uncertain.

Before discussing treatment I should like to ask Dr. Howard about the changes in kidney function as clinical improvement occurred in his third case.



We will all agree that the pediatrician and the practitioner see these children before bone changes occur, when treatment can be effective. It is of little benefit to the patient to establish drainage, remove obstruction and fight infection when kidney insufficiency is well established and bone changes are present. In patients with chronic urinary tract infection we must not be misled by good kidney function and by apparent well-being, but must constantly bear in mind that changes in the kidney are slowly but surely progressing and will eventually lead to renal failure. It is up to us to present these cases to the urologist at a time when treatment can be effective.

DR. T. LEON HOWARD (*closing the discussion*): Dr. Deming mentioned the resemblance of the bone changes in renal rickets to those in Paget's disease, and there must be a similarity, for I asked one of our pathologists to give his opinion of the slide from which the photomicrograph (Fig. 6) was made, and without hesitation he said it was the bone from a case of Paget's disease. He frankly admitted he had never seen the bones of a renal rachitic.

The thymus showed no pathology and in none of the case reports I have seen, has the thymus been described as a possible factor.

I still insist it is a disease of paradoxes and offers the widest field for research, especially from a hormonal standpoint, to say nothing of the renal and parathyroid relationship.

The copy of this paper sent to Dr. Beer unfortunately omitted the pathologist's microscopic report on the parathyroids, but I assure him there was no adenomatous change in any of the glands and their enlargement is due to hyperplasia, as shown in Figure 13. I mentioned the fact that there was a difference in the blood as well as in the bones in patients having adenomas of the parathyroids, for in this condition the exciting lesion is in the parathyroid, while in the renal rachitic the parathyroid change is secondary, and is a physiologic result of the renal and blood pathology.

The urologist will be of little benefit in the type of patient I reported in detail, for the bone changes begin early in life, due to some unknown prenatal renal defect. But in the other two cases, if the physician will allow the urologist to see this obstructive type early enough, I feel sure he will be able to prevent, in a certain percentage, the bone changes which are unquestionably secondary to the renal pathology.

Dr. Beer is, of course, correct in that all cases of lower renal obstructive lesions do not go on to the rachitic state, and I didn't intend to leave such an impression.

In closing, I want to thank the members of the Academy for being allowed to present the subject of renal rickets for their consideration and to the discussers for their most generous and frank opinions.



# DIFFICULTIES IN URETHRAL CATHETERIZATION

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ONE usually thinks of urethral catheterization of the male patient as too simple a procedure to warrant much consideration. Yet there is hardly a physician in practice today who has not at some time been in the very embarrassing position of being unable to pass a urethral catheter to relieve a distressed patient who has had a full bladder. At The Mayo Clinic we daily have inquiries from visiting physicians as to our equipment and manner of procedure in handling patients who are difficult to catheterize. Nearly every young physician taking graduate work in a medical center, no matter what his specialty, calls on the urologic department for suggestions as to the types of catheters he should purchase before going into private practice, and for instruction in their use.

The results of unsuccessful or poorly done urethral catheterization are too commonly encountered, and they are especially serious in cases in which the patients are elderly debilitated men who are suffering from urinary obstruction as a result of prostatic enlargement or stricture of long standing. False passage of catheters, injuries to the prostate gland, urethral hemorrhages, periurethral abscesses, severe urinary infections, and unnecessary suprapubic operations and cystostomies bear witness to the difficulties that are encountered in this so-called simple procedure. The physician who does not specialize in urology often becomes so confused at the innumerable urethral instruments described in the urologic literature that he is at a loss to know just which ones to acquire and the proper indications for the use of each. For the average practicing physician to be adequately equipped for such work does not

require the large number of instruments found in the office of the urologist, but rather a carefully selected list of instruments and a thorough knowledge of when and how to use them. This brief outline is merely an attempt to suggest to the general practitioner a suitable minimal armamentarium, and to review a few practical anatomic points and technique that may be of value when he is confronted with a case in which catheterization proves difficult.

## ANATOMIC CONSIDERATIONS

It will be recalled that there are two portions of the anterior urethra in which the diameter of the urethral lumen is enlarged, namely, the fossa navicularis and the bulbous urethra. As the roof of the urethra is fixed and relatively inelastic, these variations in diameter of the urethral lumen are formed at the expense of the freely movable and elastic urethral floor. The posterior urethra is relatively fixed because the membranous portion traverses the triangular ligament while the remainder traverses the prostate gland. If the penile urethra is held at right angles to the body it forms an almost straight tube to the juncture of the bulbous and membranous portions of the urethra, from which point there is a definite fixed curve into the bladder. Normally, the anterior portion of the urethra is easily catheterized as the floor molds itself readily to the shape of the catheter. However, because of this laxity of the floor of the anterior urethra, it is also easy for one to catch the tip of a urethral instrument in a fold or pocket of mucosa and exaggerate it. (Fig. 1.) This will prevent passage of the instrument or break the mucosa of the floor and produce a false passage. For this reason, in the

passage of instruments it is always imperative to have the instrument hug the roof of the urethra.

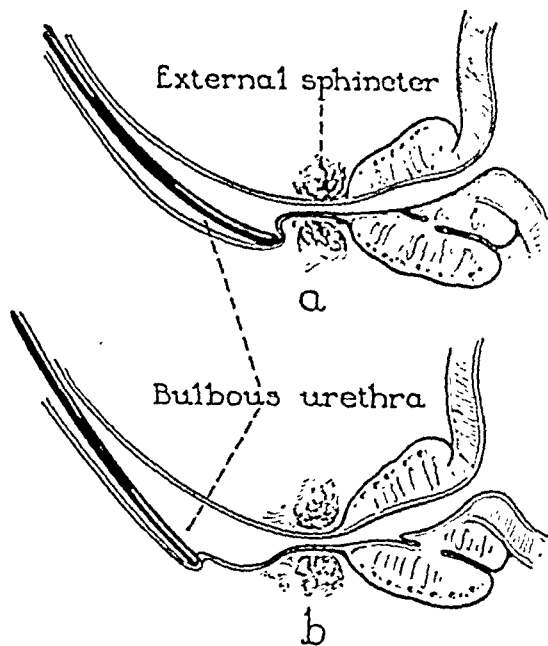


FIG. 1. A, sagittal section of normal urethra illustrating instrument caught in the floor of the bulbous urethra at its junction with the membranous urethra. B, instrument is caught in a fold of mucous membrane further out in the anterior urethra.

Probably the most common troublesome point encountered in urethral instrumentation is in the bulbous urethra. The reason for this is apparent. The lumen of the bulbous urethra is large and may sag considerably below the level of the posterior urethra. Because the posterior urethra is fixed and its entrance is guarded by the external sphincter (which normally is in a state of contraction), it furnishes a definite moderate obstruction to the passage of any instrument. The tip of the instrument has a tendency to drop into the floor of the bulb, push against the wall of the bulb and form a pocket, instead of making the upward curve and dilating the sphincter. (Fig. 1.) If too much force is applied it will result in a false passage. Spasm of the sphincter, of course, exaggerates this difficulty.

The next most common point of trouble in the normal urethra is at the internal

sphincter or neck of the bladder. It is not uncommon for this sphincter to be irritable and by its contraction form a ledge of the posterior lip of the neck of the bladder, which will catch the tip of the instrument.

In cases of prostatic hyperplasia, several other points of difficulty arise. As the urethra traverses the prostate gland near its anterior surface, most of the adenomatous tissue is found in the floor and low part of the lateral walls. When adenomatous enlargement ensues, the floor of the urethra often becomes distorted and a "pocketed urethra" commonly results. In this type of deformity the urethral floor is pulled below the level of the base of the bladder and forms a deep pocket. If there is an enlargement of the median lobe, the condition is exaggerated. Large lateral lobes which have considerable tissue in the anterior quadrant may force the instrument into the pocket despite the attempt of the operator to see that it hugs the roof.

Carcinoma of the prostate gland tends to produce an extreme narrowing of the lumen of the prostatic urethra and render it extremely fixed and inelastic. If the carcinoma is advanced, it extends down into the membranous urethra. In this type of case it is most difficult to pass urethral instruments; at times, it is almost impossible to guide an instrument into the posterior urethra.

These anatomic and pathologic factors explain why nearly all false passages occur in the urethral floor. The overwhelming number of false passages are found in the bulbous urethra, but in cases of prostatic hyperplasia it is not uncommon to see median lobes and low-lying lateral lobes that have been completely tunneled through by the instrument used for catheterization.

#### INSTRUMENTS AND TECHNIQUE

The first principle of urethral catheterization is cleanliness. There is probably no other surface in the body that so readily permits bacteria to enter the blood stream

as does the traumatized male urethra. The penis, perineum, and lower part of the abdominal wall should be well scrubbed

is holding the forceps is passing the catheter, the penis should be held on tension at right angles to the body with the



FIG. 2. Method of instrumental catheterization; the hands will not touch any part of the catheter that will come in contact with the urethral mucosa.

with soap and water and, if possible, the patient should be covered with a sterile male drape. The hands of the surgeon should be scrupulously clean and the technique should be as nearly sterile as possible. One should form the habit of handling the catheter with an instrument, as in the majority of cases the patient may be catheterized without the hands touching the catheter. The technique of this procedure is illustrated in Figure 2. If the procedure becomes difficult, the catheter must be manipulated by the hands, so this should be anticipated. Antiseptics are of questionable value but may be used if desired. Care should be taken to lubricate the catheter well.

The first attempt should be made with a number 14 or 16 French, inexpensive, soft rubber catheter which has a round, solid tip. (Fig. 3A.) While the right hand, which

left hand. This makes the urethra a fairly straight tube to the juncture of the bulbous and the membranous portions and irons out mucosal folds and pockets in the urethral floor. One of the most important points to be remembered here is to pass the catheter slowly and gently in order that the patient will remain relaxed. When the catheter reaches the bulbo-membranous urethra it will encounter the obstruction of the external urethral sphincter. Lack of gentleness at this point is the most common cause of failure. Gentle firm steady pressure on the catheter will gradually relax the sphincter and allow the catheter to enter the posterior urethra. A jerky, poking thrust will cause the sphincter to contract, and this will defeat the attempt to pass the catheter further. If obstruction is encountered from the internal sphincter at the neck of

the bladder, the same rules of procedure must be followed to overcome it. Too much haste often makes a normal urethra

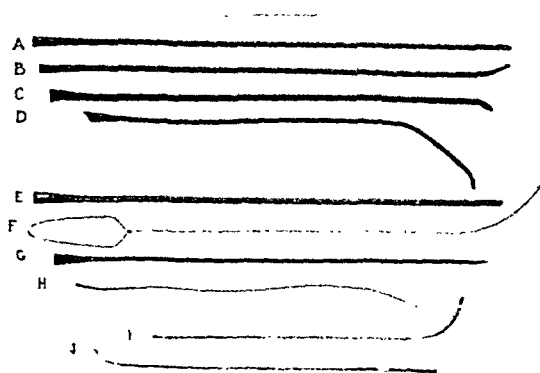


FIG. 3. Suggested assortment of catheters for the general physician: A, soft rubber catheter with round solid tip. B, soft rubber, hollow coude catheter with olive tip. C, woven urethral catheter with coude tip. D, woven urethral catheter with bicoude tip. E, soft rubber hollow catheter with round tip (Wishard). F, wire stilet with Van Buren curve. G, woven catheter with filiform guide attachment (Phillips catheter). H, filiform guide. I, metal catheter with Van Buren curve. J, metal catheter with Van Buren curve and filiform guide attachment.

an obstructive one as far as catheterization is concerned.

If, with the proper technique, the catheter cannot be passed, the most probable explanation is that the tip has caught in the floor of the bulb and is pushing the wall of the urethra ahead. (Fig. 1A.) If prostatic hyperplasia is present, the difficulty may be due to the tip of the catheter being caught in a pocket in the prostatic urethra; in this case, the catheter is unable to bend upward over the vesical neck. In either case the next catheter to try is a number 16 or 18 French, coude soft rubber catheter which has a hollow olive tip. (Fig. 3B.) This catheter has a mark on its distal end that denotes the direction in which the tip is pointing; therefore, the operator should endeavor to keep the tip pointed toward the roof of the urethra when the obstruction is reached. Gentle manipulation and firm steady pressure should cause the catheter to rise out of most ordinary pockets and find its

way into the bladder. This probably is the most useful of all urethral catheters.

If these two maneuvers fail, the third attempt should be made with a woven urethral catheter of either the coude or bicoude type. (Fig. 3C and D.) The catheters are shaped to fit the curve of the urethra, which enables them to rise out of pockets; they also possess a certain degree of rigidity which allows a little more pressure to be applied without causing buckling. The operator must always remember, however, that these catheters, though not rigid, still possess the ability to break the urethral mucosa and produce false passages if too much force is applied. These catheters should be gently manipulated, but should not be forced.

If the catheterization is still unsuccessful, the operator should remember this one important point: *do not persist too long*. If too many attempts are made the patient will become exceedingly irritable, which will make the procedure increasingly more difficult. It is much wiser to stop, give the patient a hypodermic injection of morphine sulphate,  $\frac{1}{4}$  gr. (0.016 Gm.), wait for thirty to forty-five minutes until it has taken full effect, and then proceed. This is probably the most important single point to remember in cases in which urethral instrumentation is difficult. If the patient can be made to relax, half the battle is won. In fully 85 per cent of such cases it will be a relatively simple procedure to pass a soft rubber or woven coude tip catheter after the morphine has taken effect. Often, a sitz bath in addition to the morphine is of value.

If, however, one is still unsuccessful, one of two procedures may be employed, depending on the preference of the operator: (1) a soft rubber catheter which has a hollow tip (Fig. 3E) may be threaded over a wire stilet (Fig. 3F); or (2) a woven catheter may be preceded by a filiform guide. (Fig. 3G and H.) The soft rubber catheter which has a hollow rounded tip and only one eye is called a Wishard catheter. A similar catheter which has two

eyes is called a Robinson catheter. Either type is satisfactory. A curved wire stylet which has a Van Buren curve should be

The other method of approach (insertion of a filiform guide followed by a woven catheter) is nearly always success-

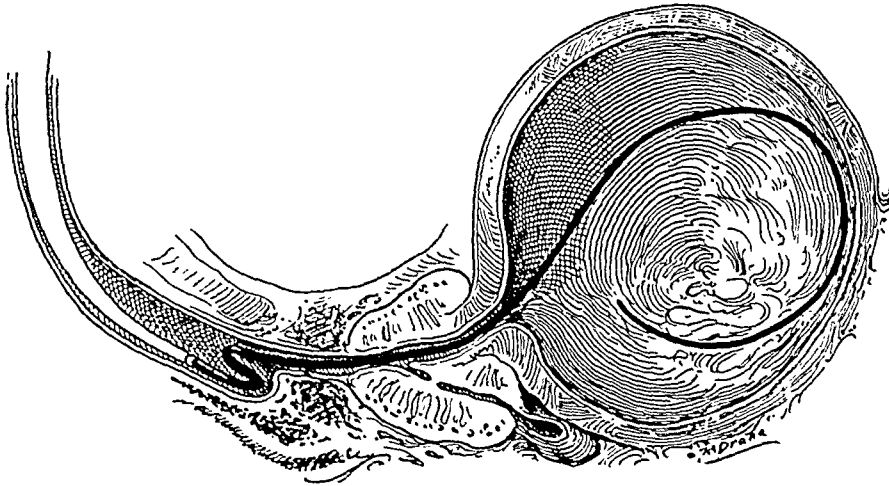


FIG. 4. Sagittal section of urethra showing a filiform guide buckling at the juncture of the bulbous urethra and posterior urethra. (From Bumpus, Crenshaw and Clark, "Minor Surgery of the Urinary Tract," Saunders, 1932.)

thoroughly lubricated and a number 18 French catheter which has a hollow tip should be threaded over it. Care must be taken to be sure that the point of the stylet is well down into the tip of the catheter and that the catheter is stretched taut so the tip of the stylet will not slip back out through the eye of the catheter and injure the urethra. It is well to use at least a size 18 French catheter; if a smaller one is employed, difficulty will be encountered in attempting to remove the stylet after the catheter has been introduced into the bladder. The operator also must realize that he is now employing a rigid instrument and that gentleness in manipulation rather than force is extremely important. With this type of equipment one is able to make the point of the catheter hug the urethra and is able to guide the tip of the catheter out of pockets and false passages. Counter pressure with the free hand on the perineum or with a finger in the rectum is often a great aid in guiding the tip of the catheter into the bladder. Again, as in all types of catheterization, one should not forget to apply tension to the penis at right angles to the body, to assist in obliterating pockets and folds in the urethral floor.

ful, produces a minimum of trauma, and is no doubt a safer procedure in inexperienced hands. If a stricture is present, this method is by all odds the procedure of choice.<sup>1</sup> The woven catheter (usually called a Phillips catheter) may be secured in sizes 8 to 30 French, and a few of the small sizes are most important. In addition to being an excellent catheter, it serves admirably for gradual dilatation of urethral strictures. The most difficult part of the technique is the passage of the filiform. It should be well lubricated, the tip should be bent into a moderate curve, and the filiform should be passed slowly by rotating it back and forth between the thumb and first finger to change the direction of the tip constantly, thereby avoiding pockets and old false passages. Sometimes, in a badly pocketed or injured urethra, it is necessary to pass several filiforms to fill up the pockets and false passages before one finally can be passed into the bladder. After the filiform has entered the bladder it is usually a simple procedure to screw on the catheter and make it follow the filiform into the urethra. This may be left in for drainage for twenty-four to forty-eight hours, following which it is usually possible to remove it and pass a soft rubber

catheter. It must not be forgotten that filiforms may buckle and break if too much force is applied. (Fig. 4.) Filiform However, much damage may be done with this instrument and in unskilled hands it is unsafe. The safer procedure, if the

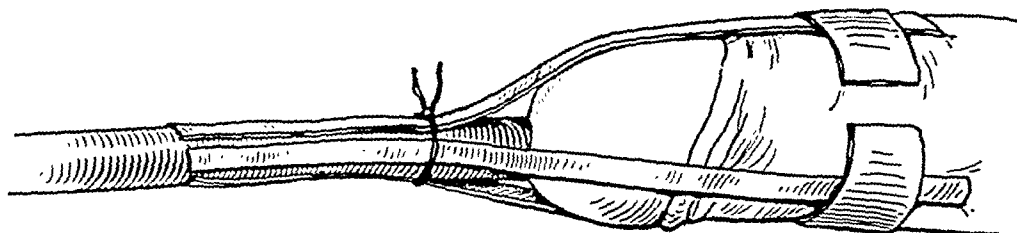


FIG. 5. A very satisfactory method of "tying in" a retention catheter; the catheter may be easily readjusted by simply cutting the ligature and peeling back the strips of adhesive tape from the catheter; after the catheter has been adjusted, the same adhesive strips may be reapplied and tied.

guides crack and break with age and use, so it is very important to examine them carefully for defects each time they are used.

patient's general condition permits, is to administer a general anesthetic, preferably gas anesthesia; this added relaxation most frequently permits catheterization to be



FIG. 6. A suitable type of closed bottle with tubing to connect with a retention catheter; the bottle is equipped with a hook to be hung at the side of the bed.

When all these measures fail, the condition is truly a difficult one. If the physician is expert in urethral manipulation he may choose to try a metal catheter, either with or without a filiform guide (Fig. 3—1 and J).

accomplished. However, if catheterization is still impossible, suprapubic drainage may be done while the patient is still anesthetized, and it is always well to remember that suprapubic drainage well

done is much safer for the patient than is the forceful passage of any urethral instrument.

#### CARE OF RETENTION CATHETERS

After catheterization has been accomplished, the physician may wish to leave the catheter in situ for several days. If the catheter is properly adjusted and tied in place, the patient will be perfectly comfortable. If the catheter is poorly adjusted it will give no end of trouble. A catheter that is inserted too deeply into the bladder may be just as uncomfortable as one that reaches only into the prostatic urethra.

A catheter to be properly adjusted should be inserted deeply, and then should be slowly withdrawn. When the catheter has been withdrawn as far as possible without interfering with the free drainage of the urine, the proper point of adjustment has probably been reached. However, after all of the urine has been withdrawn the catheter should be irrigated with a glass syringe which has a plunger. An ounce or two of fluid, when injected, should easily run back through the catheter if it is perfectly placed. It may be impossible to secure proper adjustment at first trial so the catheter should be fastened in such a manner that its position can be changed easily. There are many ways of fastening an indwelling catheter in place, but at the clinic we have found the method illustrated in Figure 5 very satisfactory. The foreskin of the penis should be well pulled down so that it will not stretch and allow the catheter to slip. Three strips of adhesive tape should be attached longitudinally, equidistant from each other, beginning well back at the base of the penis and extending down on to the catheter. The strips should be secured to the penis by a circular strip of adhesive tape. Instead of placing a circular strip of adhesive tape around the longitudinal strip on the catheter, it is much better to tie the strips of adhesive tape with fishing line or some other good strong ligature as illustrated. By using this method, if one desires to change the

position of the catheter it is necessary only to cut the ligature, pull the strips off the catheter, adjust the catheter, and then reapply the strips and tie them again. This may be done many times as the tie will hold the strips securely to the catheter even though most all of the adhesive property of the tape is gone.

When a catheter is left in place for several days it is important that free drainage for urethral secretion should be maintained around the catheter. The longitudinal strips of adhesive tape should be narrow enough to prevent occlusion of the urethral meatus. It is also good policy to inspect the meatus once daily and push the glans penis well back from the adhesive tape to prevent any secretion or discharge from becoming hard and hampering free urethral drainage.

The care of the indwelling catheter is of paramount importance. If the end of the catheter is left free in a urinal or some other shallow receptacle, the chances for an ascending infection are very great. The catheter should be connected by means of a glass adapter to a long sterile rubber tube that may be attached to a closed sterile bottle of some type by the side of the bed. One suitable variety of connection and bottle is illustrated in Figure 6. Each time the bottle is emptied it should be boiled before it is replaced. It is only by adherence to this type of technique that severe urinary infections may be reduced to a minimum in cases in which continuous catheter drainage is employed.

#### SUMMARY

Urethral catheterization of the male patient may at times become a very difficult procedure, and if not skillfully done, it may result in serious consequences to the patient. The anatomy of the urethra should be carefully borne in mind, as false passages are most commonly made in the floor of the bulbous urethra, due to the laxity of the floor of the bulbous urethra and its position in relation to the external sphincter and the fixed prostatic urethra.



It is always well to attempt to hug the roof of the urethra with the urethral instrument. Relaxation of the patient is most important and is best secured by gentleness of manipulation. If necessary, morphine should be employed. A well-selected group of the various types of catheters and a knowledge of when and how to use them will nearly always solve the problem of difficult catheterization. When a catheter is to be left in place for

any length of time it should be properly adjusted and fastened in such a way that its position may be readily changed if it slips out of adjustment. A sterile connection to a sterile closed receptacle will reduce ascending urinary infection to a minimum.

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GONOCOCCAL infection of the testis and epididymis responds rapidly to diathermy. Pain is quickly abolished. . . . Tenderness and swelling subside. . . . Inflammatory thickening of the skin of the scrotum disappears. From—"Diathermy" by Elkin P. Cumberbatch (William Wood).

# TRAUMATIC LESIONS OF THE KIDNEY

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**A**LTHOUGH injury of the kidney is relatively common, divergent opinions persist regarding the proper management of these cases and the late results that may be expected following various types of immediate treatment. The present study is based on forty-five cases in which the diagnosis of ruptured kidney was made at the Mayo Clinic from 1910 to 1933, inclusive. We considered only those cases in which the kidney had been ruptured by external violence without penetration of the skin.

Twenty-four of the patients were seen immediately or within one week following injury, eleven were first seen from one week to one month following the initial injury, and the remaining ten patients were first seen from one month to several years or more following injury. Thirty-one of the forty-five patients have been followed to the present time. The literature is not reviewed in detail, but for those who are interested a small bibliography is appended.

## INCIDENCE

The incidence of ruptured kidney as compared with other traumatic lesions is relatively low. Most renal injuries occur during the period of life when physical activity is greatest. In the present series of cases, the youngest patient was 3 years of age, the oldest 65, and the average age was 26.4 years. Injury occurred as often on one side as the other, and there was no case of bilateral injury. There were approximately six times as many males as females in this series. The fact that men commonly engage in activities which predispose to trauma, and the fact that the lumbar region in women is protected by a wide iliac crest and a thick layer of adipose tissue, may explain the higher incidence of renal

injuries in men. Children have a small amount of perirenal fat and a more elastic and less well developed thorax than adults, and consequently injury to the kidney may occur more readily. A markedly diseased kidney may be ruptured more easily than a normal one. In the present series of cases in so far as we could determine, only three kidneys were abnormal at the time of injury. One of these revealed hydronephrosis and contained stones; another was invaded by a tumor of the suprarenal gland, and the third, which was removed nine months after injury, revealed a small amount of tuberculosis, which was apparently an incidental finding.

## ETIOLOGY

Various types of trauma may result in rupture of the kidney. In the present series of cases falls, automobile accidents, and kicks in the lumbar region were the three most frequent forms of trauma, falls alone constituting approximately 40 per cent of all injuries. In general, any force of sufficient magnitude applied to the renal region, whether it be a severe blow or a compressing type of trauma, may result in rupture of the kidney. Severe muscular contraction or a forceful fall on the feet or buttocks may cause sufficient violence to the kidney to result in rupture. There were three cases in which muscular pull alone was responsible for the injury, and this occurred while the patient was lifting a heavy object.

## PATHOLOGY

The type of renal injury that occurs is variable and is not necessarily dependent on the nature or severity of the trauma. (Fig. 1.) Küster<sup>19,20</sup> emphasized the importance of hydrostatic pressure within the kidney acting against compression from

without, and thought that physical laws of pressure rather than anatomic relationships were responsible for the lesions that

usually being composed of blood and urine in varying amounts.

If injury has not been too severe, healing

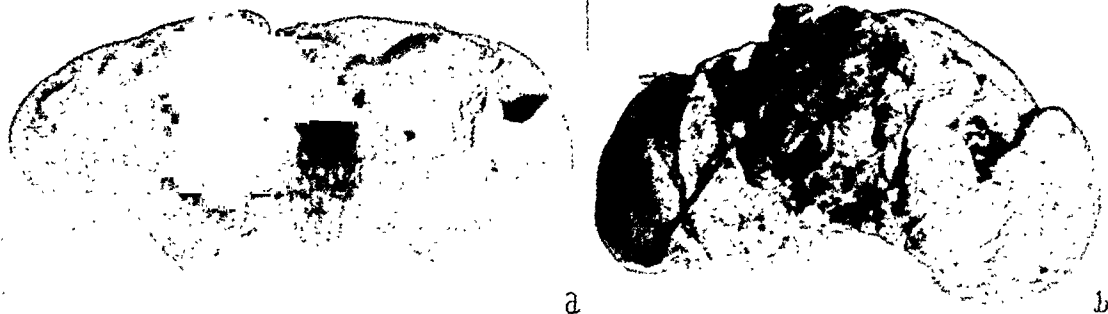


FIG. 1. Two ruptured kidneys for which nephrectomy was performed in each instance.

occur. The injury may vary from only a slight extravasation of blood beneath the capsule to complete pulpefaction of the kidney. Occasionally the upper or lower pole may be torn loose, but most commonly one or more deep tears occur in the parenchyma and hematuria results. The renal pedicle may be avulsed or the ureter may be completely severed, in which case hematuria is usually absent.

Hemorrhage may be slight or profuse, depending on the extent of the injury. There is often extravasation of considerable blood into the perirenal tissues, forming a palpable tumor in this region. If hemorrhage remains confined within the fascia of Gerota, the increased pressure that gradually results will usually stop bleeding before exsanguination occurs. In contrast, if the peritoneum is lacerated, blood may escape freely into the abdominal cavity and hemorrhage may be fatal. The most severe hemorrhage occurs when the vessels of the renal pedicle are torn.

If injury is insufficient to cause complete cessation of renal function, urine continues to form, and it may escape into the perirenal tissues and increase the size of the hematoma that is already present. If there is no infection this extravasation remains sterile. However, if infection is present, or develops later, a large abscess often results. Approximately one-third of the patients in this series had a mass in the perirenal tissues following injury, the mass

may take place with a satisfactory functional result, although some anatomic deformity may persist. (Fig. 2.) In other cases immediate healing will be unsatisfactory and undesirable sequelae will develop. The most frequent causes of trouble soon after the injury, other than hemorrhage, are renal and perirenal infection and a persistent urinary fistula that may develop following the evacuation and drainage of a perirenal hematoma or abscess. The two most common late conditions which cause trouble are traumatic hydronephrosis and traumatic pseudohydronephrosis. A true hydronephrosis may result from obstruction by scar tissue in the region of the upper portion of the ureter. This may develop within a few months and not cause symptoms for some years. Three such cases were observed in the present series. If the renal pelvis or ureter is torn and urine escapes into the perirenal tissues, pseudohydronephrosis may result. Such a perirenal collection of urine may be gradually absorbed or partially drained through an existing connection with the renal pelvis or ureter. In the latter instance, a communication exists between the pelvis or ureter and a cavity in the perirenal tissues in which urine may collect intermittently. This might be compared to a diverticulum of the bladder in which urine collects and becomes stagnated and is then emptied more or less completely. It is quite common for infection to appear under such circum-

stances, and pain, chills and fever often result. Pyelographic studies will usually differentiate true hydronephrosis from

intra-abdominal lesions of any severity occurred in only two cases. In one case there was rupture of the spleen; in the



FIG. 2. Intravenous urogram (June 1936) showing residual anatomic deformity of left kidney but good function. The patient, a boy aged 8 years, injured his left kidney by a fall in August 1934, a perirenal hematoma being evacuated at this time. In 1936, the urine was sterile and the patient had no symptoms.



FIG. 3. Bilateral retrograde pyelogram (November 20, 1931) showing normal left kidney, and some dilatation of the pelvis and rather abbreviated calyces but no extravasation of medium on the right side. The patient, a man aged 30 years, injured his right kidney, November 1, 1931, there being gross hematuria for ten days, and localized pain and tenderness in renal region for three weeks. Medical treatment was employed. The patient was free of symptoms four years later.

pseudohydronephrosis. Renal function following injury depends largely on the nature and extent of the traumatic lesion and the effect that healing has on the normal anatomic relationships of the kidney and ureter.

#### ASSOCIATED INJURIES

It seems superfluous to mention that every patient who has a ruptured kidney should be carefully examined for any co-existing injury. In the present series of cases there were very few such injuries found. The nature of an accident which causes rupture of the kidney is oftentimes such that there is no external evidence of violence or any injury in other parts of the body. In only three cases did cutaneous abrasions require special attention, and

other, rupture of the liver. Skeletal injuries were found in six cases in all and included a fractured skull, a fracture of the twelfth thoracic vertebra, fractured ribs in three cases, and a lacerated scalp and fractured fibula in another case.

#### DIAGNOSIS

The three cardinal features in cases of rupture of the kidney are: (1) a history of trauma; (2) hemorrhage; and (3) pain. Occasionally trauma may be very slight, as in the case reported by Voit in which a woman's kidney was ruptured by pressure from her husband's hand while they were waltzing. Hemorrhage is manifested either

as hematuria or as a perirenal hematoma or both. Gross hematuria occurred in 75 per cent of cases, and microscopic hematuria

Pain of varying degree is invariably present, and localized tenderness and rigidity in the renal region are in propor-



FIG. 4. Right retrograde pyelogram made six months following injury shows only slight clubbing of calices. The patient, a man aged 43 years, had microscopic hematuria for five weeks. He received medical treatment and was perfectly well six years later.



FIG. 5. Right pyelogram, showing marked deformity of pelvis and calices, especially the middle and lower ones. The patient, a man aged 51 years, injured his right kidney by a fall September 17, 1930. There was gross hematuria for two weeks, and severe pain and tenderness in the right renal region for several weeks. On admission to the clinic May 26, 1931, he complained of pain in right side. Infection was present in right kidney and its function was markedly reduced. The left kidney was normal. Nephrectomy was performed June 3, 1931, and the patient was entirely well three years later.

was present in 95 per cent. Gross hematuria may occur only once or twice, or it may persist for several weeks. Occasionally it disappears after a day or so and recurs a short time later. Microscopic hematuria usually persists for some few days following cessation of gross bleeding. There seems to be no definite relationship between the amount or duration of the hematuria and the extent of the renal injury or necessity for operation. As a rule, however, when gross hematuria occurs, injury is usually more extensive than when microscopic hematuria alone is present. In the only two cases in which microscopic hematuria did not occur, the ureter was completely avulsed in one case, and the renal pedicle was torn in the other. At times a blood clot in the ureter may prevent hematuria and cause pain which suggests renal colic.

tion to the severity of the injury. Depending on the nature and extent of the injury, other abnormalities may be present. A mass was found in the flank in approximately one-third of the cases, and in this group it is interesting to note that all but one of the patients were subjected to immediate operation. If infection occurs in a perirenal collection of urine and blood, chills, fever, and increased pain may appear. Sometimes the localized tenderness and rigidity in the renal area render palpation of a mass rather difficult.

Definite evidence of shock occurred in only three cases, and each of these patients

had additional injuries, namely, rupture of the spleen, rupture of the liver, and fracture of the skull. There may be complete suppression of urine during the period of shock. Other patients presented varying degrees of faintness, pallor, weakness, nausea, and vomiting, which were usually proportional to the amount of pain and severity of the trauma. Shock immediately following trauma is usually caused by the severity of the injury, whereas shock which develops later is more often caused by hemorrhage.

The abdominal findings will vary according to the amount of abdominal trauma and the presence of blood within the peritoneal cavity. Some abdominal tenderness, rigidity, or distention may be present without any actual intra-abdominal lesion, so-called traumatic peritonism. In these cases the signs and symptoms of peritoneal irritation gradually subside and disappear in contrast to those in which an actual lesion is present. The pulse rate may be elevated by shock, pain, excitement, or bleeding. Significant changes in blood pressure are not usually noted except in cases of shock or gross hemorrhage. Some fever soon after injury is common (in 50 per cent of cases) unless shock is present, and occasionally chills may also occur. The occurrence of chills usually signifies a more serious condition for which operation will probably be necessary.

Routine laboratory studies immediately following the injury usually reveal nothing very remarkable. The values for hemoglobin and erythrocyte and leucocyte counts are quite commonly within normal limits, although leucocytosis often develops within a short time. Subsequent blood counts vary, depending on the amount of bleeding, the general condition of the patient, and the amount of infection that is present. The value for urea in the blood is usually normal if the opposite kidney is in good condition at the time of injury.

Complete urologic investigation, including cystoscopy and pyelography, is often unnecessary and may even be undesirable

immediately following injury, although some urologists feel that without such investigation accurate diagnosis cannot be made. Intravenous urography is of definite value and should be performed soon after the injury if the condition of the patient permits. If function of the involved kidney is greatly impaired, either temporarily or permanently, there may be complete failure of visualization, in which case cystoscopy and retrograde pyelography may be indicated. The essential points in the diagnosis, namely, history of injury, pain in the renal area, and hematuria together with the associated physical findings and general condition of the patient, often afford adequate evidence on which to base one's opinion regarding the proper treatment, although an intravenous urogram is almost always desirable. A plain roentgenogram of the urinary tract does not usually supply valuable information immediately following the accident. A roentgenogram of this type was made in the majority of our cases, and in only two did it demonstrate anything of significance. In one case there was a mass of increased density in the region of the kidney, and in the other, stones were visualized in the ruptured kidney. If cystoscopy is not performed immediately, complete urologic investigation is indicated later, especially if progress is unsatisfactory.

#### TREATMENT

It is difficult to be dogmatic regarding the proper treatment for recent rupture of the kidney as this depends on the extent and severity of the injury and the general condition of the patient. In our opinion conservative treatment is usually advisable unless it is definitely contraindicated, as many ruptured kidneys heal satisfactorily without surgical intervention. (Figs. 3 and 4.) Of thirty-eight patients seen immediately or soon after injury, twenty-five (65.8 per cent) were treated medically. Medical treatment consists of rest in bed, careful clinical observation, proper treat-

ment of any associated injuries, the administration of an adequate amount of fluid, morphine for pain, and general nursing attention. Occasionally, cystoscopy and ureteral catheterization may be necessary if a blood clot becomes lodged in the ureter. This occurred in several of our cases and prompt relief of obstruction and pain followed the establishment of drainage through a ureteral catheter. Hematuria, in our experience, is seldom of sufficient severity to become alarming, although bleeding into the perirenal tissues or peritoneal cavity may be very profuse and require transfusion and prompt surgical attention. In the average case which does not require operation, hematuria subsides and the general condition of the patient improves so that he may leave the hospital within approximately one or two weeks following the injury.

Thirteen (34.2 per cent) of the thirty-eight patients, seen because of the immediate effects of injury, were operated on. These thirteen patients may be divided into two classes: (1) those operated on at once or within a day or two following the accident, and (2) those subjected to operation only after a period of medical treatment, for a few weeks or longer, had failed to give satisfactory results.

The commonest cause for immediate operation was excessive bleeding, and this was usually confined to the perirenal tissues, but occasionally entered the peritoneal cavity. Under these circumstances a large perirenal hematoma is usually present which is caused by a tear in the renal vessels or by large rents in the parenchyma of the kidney. It is usually imperative to perform nephrectomy in cases of this type. At times a badly lacerated kidney can be preserved by large mattress sutures tied over a piece of muscle or fatty tissue. The use of ribbon catgut tied around the kidney, as advocated by Lowsley, may be quite helpful in saving a ruptured kidney. But regardless of whether or not the kidney is removed, the indication of most immediate importance is to control the bleeding.

Medical treatment may be followed by unsatisfactory progress in a certain number of cases. (Fig. 5.) This is usually caused by some leakage of urine into the tissues surrounding the kidney or some obstruction to free renal drainage. Occasionally a persistent perirenal hematoma will cause trouble. Most commonly a mass gradually forms in the renal region. This may be quite tender, and chills and fever may occur. Cystoscopic examination often reveals a practically functionless kidney on the affected side. Incision and drainage of the mass, as a preliminary, conservative operative procedure, liberates a large quantity of foul, and sometimes bloody, urine or pus. In six cases of this type in the present series subsequent nephrectomy was necessary in each case because of a persistent urinary sinus, a functionless infected kidney, recurrent perinephritic abscess, or an otherwise badly damaged kidney.

Occasionally incision and drainage of a perirenal collection soon after injury may be all that is necessary even though intermittent urinary leakage may occur for a while. In November 1934, we saw a boy,\* aged 8 years, who had an intermittent urinary fistula from the left kidney following the incision and drainage of a perirenal mass resulting from a ruptured kidney six weeks prior to his first visit to the clinic. We did not advise immediate operation, although urography revealed that only the lower half of the left kidney remained and functioned. Soon afterward urinary leakage stopped entirely, and the patient had had no further trouble when last seen in June, 1936.

It is possible, as suggested by Judd some years ago, that an early conservative operation in certain cases might obviate the necessity for subsequent nephrectomy. The difficulty arises in determining soon after the injury in just which case such an operation might be feasible. As a rule, if operation is not performed and if the immediate convalescence following injury

\* This case is not included in present series because of the short period of follow-up.

is satisfactory, no further serious trouble need be expected. It is true that this does not necessarily mean that the injured kidney is entirely normal, as such is not usually the case; it is, however, symptomless, working to some extent, and therefore of value to the patient, particularly if disease should occur subsequently in the opposite kidney. In exceptional cases, however, months or years following the accident, deformities resulting from scar tissue and other traumatic sequelae may require operation. Most commonly a practically functionless kidney which shows definite hydronephrosis and usually some pyelonephritis will be found. Nephrectomy is commonly necessary in these cases.

#### RESULTS

There were two deaths in this series of forty-five cases, but neither was primarily caused by the renal injury. In one case there was an associated rupture of the liver, and in the other rupture of the kidney occurred in the presence of an associated carcinoma of the suprarenal gland with metastasis. Of the remaining forty-three patients, thirty-one have been followed to the present time, a period of from four to twenty-six years. Of these thirty-one patients, eleven underwent nephrectomy, and in one case abdominal exploration and drainage of a perirenal hematoma was performed. All twelve of these patients have remained entirely free of any symptoms referable to the urinary tract. The remaining nineteen patients in this group who were followed up to the present time were treated medically; fourteen (73.7 per cent) of them are entirely well, but five (26.3 per cent) continue to have some symptoms apparently related to the previous renal injury. Three of the five complain of slight pain which is noted at times in the region of the injured kidney; one has pain that is moderately severe and some burning on urination, and the remaining one has urinary frequency and notices pain in the renal region on heavy exertion.

The late results following rupture of the kidney are obviously more uniformly satisfactory after nephrectomy than after medical treatment; however, none of those whose symptoms still persist following conservative management of the original injury is incapacitated. If symptoms are sufficiently troublesome in these cases, operation can always be performed. With the exception of one patient, the complaints are all mild and occur only infrequently.

#### SUMMARY

Forty-five patients who had rupture of the kidney were studied. The majority of them were young adult males. Only those cases were considered in which the kidney was ruptured by external violence without penetration of the skin. The type of renal injury varied from slight subcapsular hemorrhage to complete pulpefaction of the kidney. In some cases the ureter or renal pedicle was completely avulsed. Hemorrhage, usually perirenal, but occasionally intraperitoneal, was uniformly present, and hematuria, either gross or microscopic, occurred in 95 per cent of the cases. Leakage of urine around the kidney was common. Serious associated injuries elsewhere in the body were present in 13.3 per cent of cases. Healing may occur satisfactorily with medical treatment, or on the other hand urinary fistulas, hydronephrosis, pseudohydronephrosis, pyelonephritis, or anatomic abnormalities of varying degrees may persist or develop. A history of trauma and hemorrhage and pain are cardinal points in the diagnosis, but they should also be substantiated by intravenous urography. In general, medical treatment immediately following the injury is preferred unless contraindicated. In certain cases in which patients are treated medically, subsequent operation may become necessary.

The two deaths that occurred in this series of forty-five patients were attributed to severe extrarenal trauma. Thirty-one patients were followed for a period of from four to twenty-six years following injury.



Eleven patients who underwent nephrectomy are entirely free of symptoms; 73.7 per cent of those treated medically are entirely well, and the remainder of this group have mild symptoms referable to the urinary tract.

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# MEASUREMENT OF KIDNEY FUNCTION BEFORE, DURING, AND AFTER PREGNANCY

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MANY women with nephritis have become pregnant. Some have lost their babies, while others have lost their lives or have suffered increased permanent kidney damage. Eclampsia has been called uremia or nephritis, and nephritis has been diagnosed as eclampsia. Many women with severe nephritis have been allowed to become pregnant and to carry their babies without any warning as to the condition of their kidneys, and many women who have had toxemia of the eclamptic type have been warned never to become pregnant again because of kidney disease. These mistakes constitute a strong argument in favor of an accurate estimation of the kidney function of nephritic and of toxemic patients.

In the case of a patient with nephritis, kidney function should be determined frequently—not only during her pregnancy and subsequently, but also, if possible, before she becomes pregnant. Occasionally a nephritic patient consults her physician for the treatment of sterility. Study of her renal function may reveal the kidney efficiency to be seriously impaired, so that instead of being treated for sterility she should be warned against pregnancy. In the case of the toxemic patient the kidney function should likewise be tested during and after pregnancy. Hence, with certain degrees of kidney dysfunction the physician can advise his patient against pregnancy. If the patient is already pregnant, he can foresee probable severe renal insufficiency and either interrupt the pregnancy or induce premature labor to avoid the development of this condition. It is possible, therefore, by means of kidney function tests, to determine with a fair amount of accuracy which patients can safely become pregnant and to predict which patients will

suffer permanent additional damage if allowed to continue with pregnancy.

Kidney damage of any practical importance to the physician is measured by decrease of kidney function. There are numerous tests for kidney function, all based upon one of three principles: (1) the elimination of administered substances such as dyes; (2) the excretion of nitrogenous waste materials; or (3) the ability to concentrate and dilute urine.

The primary physiologic function of the kidneys is to excrete water in the form of urine. It follows, therefore, that tests which measure the ability of the kidneys to excrete water and concentrate urine measure the kidney function most accurately. Those best suited for this purpose are the Volhard<sup>1</sup> dilution and concentration tests. They are the easiest to perform and have best stood the test of time.

The Volhard dilution test is predicated upon the fact that normal kidneys under normal conditions will excrete fluid within three hours after it has been ingested. The test, however, is not satisfactory in the presence of edema because a large quantity of water often acts as a diuretic when it is taken after a period without fluid intake. Some of the fluid held in the tissues as edema may pass through the kidneys during the dilution test and thus increase the amount of urine obtained. This would give a false idea of the ability of the kidneys to excrete ingested fluid and would cause misinterpretation of the results of the test. If edema is present, it should be reduced by appropriate therapy—rest, magnesium sulphate, and limitation of fluids and salt. If the edema is marked and persistent, and other causes have been ruled out, one may assume that renal insufficiency is present, and the dilution test is not neces-

sary. Fever, with its associated increased loss of fluid from the skin, will decrease the amount of urine obtained and also give a false result.

For the test the following directions are given to the patient:

Take the evening meal with not over two glasses of fluid at 6 P.M.; then take no food nor fluid, except that specified, until the test is completed. At 8 A.M. the next day empty the bladder and discard the urine. Between 8 and 8:30 A.M. drink three pints of water or weak tea (if any of this is vomited, discontinue the test and start all over again that evening). At 9:30, 10:30, and 11:30 in the morning empty the bladder and save the urine. Put the three specimens together and bring them to the office. After voiding at 11:30 the test is completed and you may eat or drink as you desire.

There should be more than 1250 c.c. of urine if the kidney function is normal. Less than that amount is indicative of decreased renal function. Eleven hundred cubic centimeters would give evidence that there is beginning decrease in excretory ability, while 900 c.c. would show that marked insufficiency exists.

The concentration test is based upon the ability of normal kidneys, under suitable conditions, to concentrate urine to a high specific gravity. It has been shown by Richards<sup>2,3</sup> that less than 10 per cent of the fluid filtered into the glomerular spaces gets into the collecting tubules in the form of urine. The other 90 per cent, or more, is reabsorbed in the tubules. Hence, it may be stated that the primary physiologic function of the renal tubules is reabsorption. Any impairment of function of the tubules interferes with their ability to absorb fluid and to concentrate urine. Such a decrease in absorbing ability is measurable by the Volhard concentration test. This test, too, is of no value in the presence of edema.<sup>4,5,6</sup> For this test the following instructions are given to the patient:

Take the evening meal at 6 P.M. with not over two glasses of fluid; then take no food nor fluid until the test is completed. At 8 A.M.

empty the bladder and discard the urine. At 9 A.M., 10 A.M., and 11 A.M. empty the bladder and save the urine in bottles marked 9, 10, and 11. Bring these bottles of urine to the office.

When the patient brings these three specimens to the office the specific gravity is measured. If there is an insufficient quantity in any one bottle the contents of the others may be added.

After a period of from fifteen to seventeen hours without fluid intake normal kidneys will excrete protein-free urine with a specific gravity of 1.030 or more. Freyberg and his co-workers<sup>7</sup> give 1.029 as the minimum. If the kidneys are normal, at least one of the collected specimens should have a specific gravity of 1.030 or more. If not, there is a decrease in kidney function. This decrease is roughly proportionate to the difference between the specific gravity obtained and 1.030. For example, if the highest specific gravity obtained were 1.022, moderate renal insufficiency would be shown, but if 1.016 were the highest obtained, it would indicate a more severe renal insufficiency. It must be remembered that any quantity of protein in the urine will raise the specific gravity above that of identical protein-free urine.<sup>5</sup> Specimens obtained in the concentration test should be tested for protein. If it is present in a demonstrable amount correction of the specific gravity should be made. This may be done accurately enough for practical purposes in the following manner:

Take the specific gravity of a protein-free control urine. Then add enough serum to the control urine to give a protein test qualitatively equal to the concentration specimen and repeat the specific gravity test. The difference between these two readings is due to the added protein and should be subtracted from the specific gravity of the patient's urine. The result will be the corrected specific gravity for a protein-free concentration specimen.

Determination of the urea and creatinine concentration in the blood of patients with severe clinical symptoms of kidney

failure will often aid in arriving at a more accurate estimation of the kidney function.

It has been pointed out by numerous investigators,<sup>4,8,9,10</sup> of kidney disease that a well-marked secondary anemia nearly always accompanies chronic glomerular nephritis. This, of course, does not mean that all patients with secondary anemia have chronic nephritis, but the absence of anemia speaks against the existence of chronic diffuse glomerular nephritis of clinical significance.

Examination of the urine for albumin and sediment gives valuable information. The presence of red blood cells is evidence that an active lesion is present in the kidneys. Freshly involved glomerular capillaries bleed into the glomerular spaces. Glomerular capillaries which have been diseased a long time become hyalinized, closed, and do not bleed. The number and character of the cylindroids or casts varies as does the quantity of albumin present in the urine. While albumin is almost always present in chronic glomerular nephritis, and is found in considerable amount in the earlier stages, it may be very slight and occasionally absent in the urine of patients with disease of long duration or with nephrosclerosis. Casts, as a rule, are present in proportion to the albumin found and may be of all sorts—hyaline, epithelial, and granular. The longer the disease lasts, the fewer are the casts to be found. This is due to the fact that as the disease progresses the involved renal units become less able to secrete urine and finally cease their function, and, as a result, no albumin nor casts are produced.

Edema, oliguria, or hypertension in the presence of chronic glomerular nephritis or nephrosclerosis should be considered evidence of renal insufficiency until proved not to be. At times the only symptom presented by the patient is hypertension, while at other times hypertension is an accompanying symptom. It is extremely important to know whether the hypertension is due to arterial spasticity or to arterial or arteriolar disease, and in this

connection ophthalmoscopic study of the retinae is important. If there is evidence of arteriolar change in the retinae, generalized arteriolar change may be expected elsewhere, including the kidneys. Other things being equal, renal arteriolar sclerosis of any degree will diminish the concentrating ability of the kidneys, while pure vascular spasticity will not.

Stander and Peckham<sup>11</sup> have written: "The absence of albuminuria, edema, symptoms and signs of decreased kidney function in the presence of a hypertension, does not speak against the existence of an underlying or developing chronic nephritis. The term 'essential hypertension,' as denoting no kidney damage, is a dangerous one to employ, as the hypertension may be the first sign to precede the development of serious renal impairment dependent upon arteriosclerotic changes in the kidney."

Huber<sup>12</sup> has shown that 99.5 per cent of the blood to the kidney passes through the glomerular capillaries before going to the rest of the kidney. Hence, if there is arteriolar disease the tubules must suffer as a result.

Stander and Peckham<sup>11</sup> and McKelvey and MacMahon<sup>13</sup> have pointed out that the maternal mortality due to chronic nephritis or nephrosclerosis, if studied over a ten year period, is about 40 per cent. That is, 40 per cent of the women with chronic nephritis die within ten years of becoming pregnant. Therefore, even if such a woman should survive pregnancy, labor, and the puerperium, her life expectancy has been enormously shortened. One cannot disregard this ten year 40 per cent maternal mortality in patients who show physical signs of kidney disease during pregnancy. As one studies the case histories presented in the excellent article by McKelvey and MacMahon, he is impressed by the fact that during pregnancy each patient showed demonstrable symptoms of arteriolar disease, renal insufficiency, or acute lesion in the kidney. Any of these symptoms demands immediate termination

of the pregnancy in order to prevent added damage to seriously diseased kidneys. The patient with concealed nephritis, however, presents a more complex problem.

Flexibility must characterize the management of a pregnant woman with suspected renal damage as pregnancy adds to the renal burden. At times a woman with damaged kidneys, but with no demonstrable renal insufficiency, will become pregnant. As the pregnancy progresses, periodic tests of the renal function may show a beginning, and occasionally increasing, renal insufficiency. If such is the case, the anticipated risk has become a factor to be considered for, as a rule, the kidney function tests will demonstrate renal insufficiency before symptoms appear. Should renal insufficiency increase from week to week, termination of the pregnancy becomes imperative if the mother's health is to be safeguarded. This should not be postponed until actual evidence of the kidney failure is manifested by anasarca, retention of urea and creatinine, or marked arterial change, since added permanent damage would, by this time, have been done to the maternal kidneys. Instead, clinical symptoms should be anticipated by frequent kidney function tests in the suspected individual, and the results of the tests should govern the treatment. *There is no more reason to wait for actual physical signs of kidney failure in a patient with chronic nephritis before terminating the pregnancy than there is to wait for demonstrable axillary metastasis before removing a cancer of the breast.*

Women without clinical symptoms of decreased renal function, but with laboratory findings of slight renal insufficiency, may be allowed to continue pregnancy if frequent tests are made to determine any increase in renal failure. The patient must be made to understand her condition and to realize that if during pregnancy there is evidence of increasing renal failure, her pregnancy will be terminated.

Pregnancy may safely continue in patients who have no clinical symptoms of

kidney insufficiency if renal function is normal as shown by the concentration and dilution tests.

The factor which determines the nephritic patient's risk is her renal function. If this is normal, as demonstrated by absence of symptoms of renal insufficiency and by the concentration and dilution tests, pregnancy may be allowed. If there are symptoms of renal insufficiency, or if the results of the concentration and dilution tests are conspicuously below normal, pregnancy is contraindicated.

No one can say what amount of kidney tissue must be destroyed in any individual before there is demonstrable decrease in kidney function. It must be admitted, however, that varying amounts of renal tissue may be rendered permanently useless without preventing the kidneys from carrying out all physiologic demands with perfect efficiency. *It is the presence of sufficient normally functioning kidney tissue to carry on without any embarrassment all of the demands put upon it by pregnancy that determines the safety factor of the patient.* The hazard which pregnancy entails to a woman with diseased kidneys can be determined by a careful correlation of the ascertainable factors.

#### SUMMARY

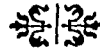
An accurate estimation of the kidney function should be made in every pregnant patient with nephritis or with toxemia of pregnancy. This can be done by correlating the symptoms and laboratory findings with the Volhard water tests. The kidney function should be estimated at frequent intervals, both during and after pregnancy, when a woman is suspected of having kidney disease. It is the presence of sufficient normally functioning kidney tissue to carry on without any embarrassment all of the demands put upon it by pregnancy that determines the safety factor of the patient. If there is insufficient normally functioning kidney tissue present for this purpose, the pregnancy should be terminated in order to

safeguard the life and future health of the mother.

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# TRANSPERITONEAL EXCLUSION CESAREAN SECTION THROUGH THE LOWER UTERINE SEGMENT

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**P**ROBABLY no operation in the history of medicine has a more ancient and fascinating history than that of cesarean section. Its growth and development have extended over many hundreds of years and while this maturing process has left in its wake a disastrous trail of maternal mortality, from it has emerged a technique which has been life saving to both mother and child.

The earliest history of cesarean section dates back to about 700 years B.C. The operation was referred to by the early Egyptians, and the Lex Regia of Numa Pompilius commanded the removal of the child before the burial of the mother. The fact that Felkin, an African traveler, witnessed a cesarean operation in Africa in 1879, would lend credence to the fact that the operation was not unknown to the natives of that country at an early period.

About 1500, one J. Nufer of Switzerland, a swinegelder by profession, delivered his own wife by section, after many midwives and barbers had attempted delivery. Then in 1581, F. Rousset published a report of fifteen cases of cesarean section, but it is not unlikely that a number of these deliveries were extra-uterine pregnancies.

The first authentic and accepted cesarean section on a living woman was performed by J. Trautman of Wittenberg in 1610, and amazing as it may seem, very little progress was made from that time for over a period of two hundred years. Because of the appalling mortality the cesarean operation was only used as a last resort, the effort being directed primarily towards saving the child and, hopefully, the mother.

Porro, in 1877, because of the high mortality, advised amputation of the body of the uterus. This operation became

generally accepted and popular; it remained in vogue until Sanger in 1882 revolutionized cesarean section by describing an accurate technique and insisting on certain cardinal principles of modern surgery. With the improvement in technique, the Sanger operation made rapid strides and soon became recognized as the accepted procedure, displacing to a great extent the more radical operation of Porro.

It soon became evident, however, that the classical section, while a great step forward, did not solve the problem of the patient with an infected uterus, as the very nature of this operation, being intraperitoneal and intra-abdominal, invited bacterial invasion rather than protected the abdominal cavity against it. Prior to Sanger's accomplishments, accoucheurs had attempted to perform an extraperitoneal operation. In 1809, Joerg proposed a flank incision and in 1821 Ritgen performed this operation. Baudelocque, in 1823, and Physic of Philadelphia, in 1824, also recommended an extraperitoneal section. Gaillard Thomas, in 1871, revised the operation known as laparoelytrotomy and reported thirty-two cases, but later abandoned the operation in favor of the classical section.

It was not until 1906 that Frank<sup>2</sup> of Bonn, suggested his extraperitoneal delivery. Dissatisfied with the classical operation and its results in women who were either infected or potentially so, Frank was led to experiment with various incisions. The results of his observations showed that the lower uterine incisions were more prone to drain into the "vesico-uterine excavation" than were the higher incisions. This fact and his preference for the deep transverse uterine incision of Kehrer were undoubtedly factors in influencing him

in his original extraperitoneal operation. Frank's procedure was as follows: "Following a transverse incision of the abdominal

advocating a longitudinal incision, both in the abdominal wall and in the lower uterine segment.

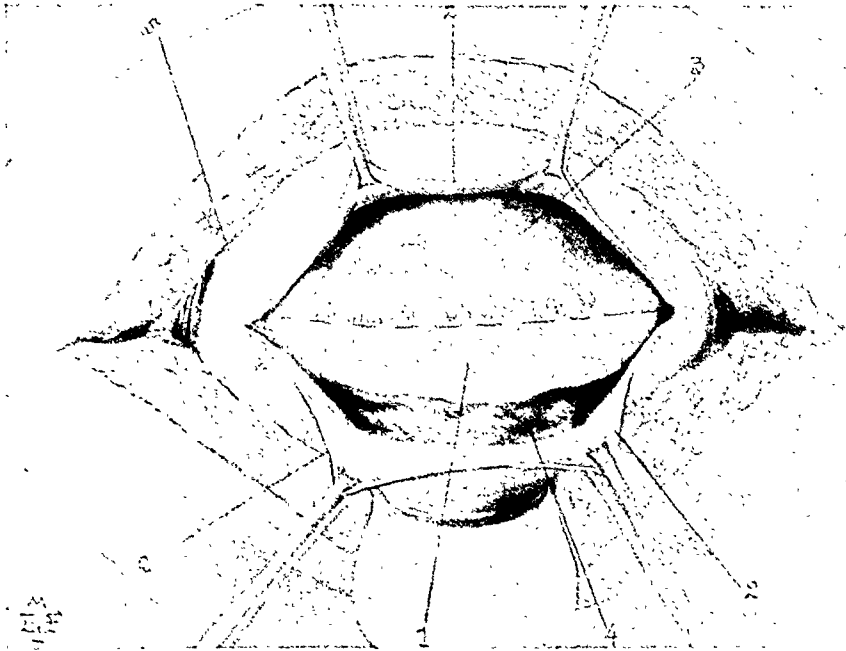


FIG. 1. 1, Uterovesical fold of peritoneum—injectd with sterile saline solution. 2, Parietal peritoneum. 3, Uterus. 4, Bladder. 5, Fascia, cut transversely.

wall, the vesico-uterine plica was incised transversely to the same extent. The wound margins of the parietal and visceral peritoneum were sutured; under these conditions a given portion of the uterus remained situated extraperitoneally and in this region the incision was made."

In 1908 Sellheim<sup>3</sup> attempted to improve on Frank's operation and suggested a true extraperitoneal operation by dissecting the peritoneum from the vertex of the bladder inferiorly. In cases where this was not practical, Sellheim also incised the peritoneal flap, attached to the bladder, and sutured the defect in the plica vesico-uterina. This he combined with the abdominal wall incision of Pfannensteil.

Many other operators suggested changes in Frank's technique, but these were mainly in the direction of the uterine incision.

The main dangers attending Frank's operation seemed to be the occurrence of abdominal hernia, hemorrhage during operation, and the time element involved. Veit theoretically obviated these dangers by

To avoid all these difficulties and dangers and to perform a truly extraperitoneal operation that would not in any way open the peritoneal cavity, Latzko<sup>4,5,6</sup> offered his extraperitoneal cesarean section, and on April 26, 1908 employed this operation for the first time. The technique consisted of filling the bladder with fluid and displacing it laterally to expose the thin distended cervix in the preperitoneal cavity. A mid-line incision was then made in the uterus, and this was followed by the delivery of the child.

The various types of extraperitoneal operations seemed to present so many technical difficulties that they gradually fell into disuse and were employed only by the occasional operator. Veit,<sup>8</sup> however, appreciative of the necessity of an operation that would be of value in the infected cases and also an operation that would fall into the realm of the ability of most surgeons, suggested in 1913 a procedure in which the uterus was brought out of the abdominal cavity, carefully covered with moist towels, emptied quickly in order not



to spill the uterine contents, and then returned to the abdomen. While this operation solved certain problems it produced

rean section in this country, and since Beck's first description of his two-flap low incision section in February 1919, many

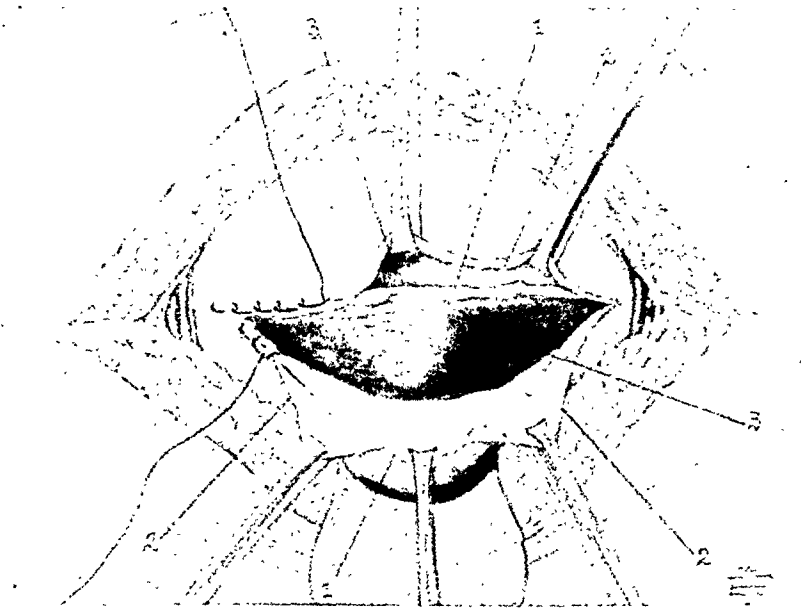


FIG. 2. 1, Uterovesical fold of peritoneum; upper and lower incised portion. 2, Parietal peritoneum. 3, Uterus.

others, mainly on account of the adhesions which inevitably formed during postpartum convalescence.

Gottschalk of Germany and Portes of France went a step further and temporarily exteriorized the uterus until all infection had subsided. The uterus was then either returned to the abdomen or amputated. Kronig contended that the main factor in the infected cases was not so much the initial uterine spill, but the seepage that occurred a few days later, and that the factor of safety, in the extraperitoneal operation was the placing of the incision in the lower uterine segment where it could be covered by peritoneum. Kronig's technique placed the uterine incision in the midline and extended well down into the lower uterine segment. Gellhorn of St. Louis modified this operation by uniting during the operation the parietal and visceral layers of the peritoneum, thus shutting off temporarily the abdominal cavity.

Beck and De Lee, with minor modifications of the Kronig operation, have done much to popularize the low cervical cesa-

rean section in preference to the classical section.

Obstetricians who have followed this method feel that there are distinct advantages in the low segment operation over the classical, which might be cited as follows: (1) less blood loss; (2) less shock; (3) the advantage of a retroperitoneal closure of the uterus; (4) a better scar for future pregnancies; and (5) a decidedly lessened danger of peritonitis.

It has been demonstrated recently in the Budeloque clinic, that at least 60 per cent of women, even when no examination has been made, show bacterial contamination of the amniotic fluid three hours after the membranes are ruptured. This being true, it is only a natural conclusion to assume that the less seepage there is and the more it is controlled in cesarean sections, the less chance there is of peritonitis.

While it has been definitely shown that the low uterine segment operations have done more than any other type of operation to reduce maternal mortality and morbidity, they lack, however, that margin

of safety that the extraperitoneal and peritoneal exclusion operations provide in the infected and potentially infected cases.

remain, however, a highly specialized operation, and in many operators' hands will carry a high morbidity if not mortality.

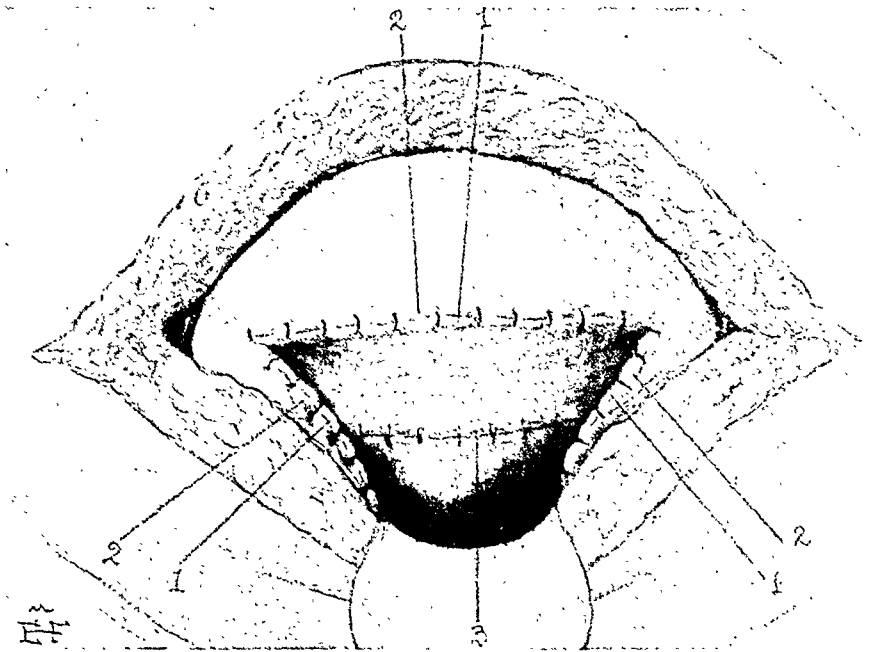


FIG. 3. 1 and 2, Uterovesical fold of peritoneum; vesical and parietal layers of peritoneum sutured together. 3, Transverse incision in lower segment of uterus sutured.

Of the peritoneal exclusion operations the Veit-Fromme-Hirst section is perhaps the best known. It carries a low mortality rate. Phaneuf<sup>15</sup> cites sixty-four cases with a mortality of 7.8 per cent and states that these deaths were due mainly to causes other than peritonitis. The Latzko operation is probably the operation of choice in severely infected women. Jellinghaus in 1923 revived this operation at the New York Lying-In Hospital, and since that time it has enjoyed an increasing popularity. Steele<sup>12</sup> and Burns<sup>13</sup> in 1930 published their results of the Latzko operation, Steele reporting an analytic study of fifty-nine cases. In 1934, Burns<sup>14</sup> reported a further study of seventy-nine patients delivered by the Latzko method. Aldridge<sup>17</sup> has also recently published a report of a series of cases of the Latzko operation with a modification of technique in incising and suturing the uterovesical fold of peritoneum, thus providing for more room in the delivery. While this operation is highly desirable in many cases, it must long

In an effort to attain as closely as possible the margin of safety that the Latzko operation gives and also to secure the advantages of the transverse low segment operation, the following technique of a modification of the original Frank operation is described.

This operation places in the accoucheur's hands a cesarean section that presents no great technical difficulties as its technique is practically that of the low transverse segment operation.

The Pfannenstiel incision gives adequate room and exposure and brings the incision directly over the uterovesical fold of peritoneum. By doubly suturing the peritoneal layers the abdominal cavity is sealed above and below. This allows the uterine incision to be placed entirely in the lower segment, entirely covered by peritoneum. It provides for the natural point of drainage into the cervix, and adds to the usefulness of the transverse low segment operation by rendering it more safe through the exclusion of the abdomen if

desired. It is not contraindicated in placenta previa.

### TECHNIQUE

*Step I.* The anesthesia may be general, spinal or local. Local anesthesia is preferable in toxic cases. Two per cent novocaine is used in the skin and 1 per cent novocaine in the peritoneum and uterus. A basal anesthetic should be given prior to the local anesthesia. Nembutal gr.  $4\frac{1}{2}$  gives good results.

The patient is catheterized, preferably in the operating room, to insure complete emptying of the bladder.

*Step II.* At the level of the anterior-superior spines, a Pfannenstiel incision  $4\frac{1}{2}$  inches in length is made. The fascia is separated from the muscles both upwards and downwards to insure plenty of fascial retraction. The muscles are divided in the midline and separated, exposing the peritoneum. The peritoneum is opened transversely to a point sufficient to expose the uterus adequately.

*Step III.* The uterovesical fold of peritoneum at its loose attachment is now picked up with plain forceps and injected both to the right and to the left with 1 per cent novocaine, if local anesthesia is being used, or sterile saline solution in case of spinal or general anesthesia. A long wheal of peritoneum will be raised. This is incised with scissors, leaving a sufficient margin of peritoneum both above and below for suturing purposes. The bladder is now dissected away from the anterior surface of the uterus for a distance of 5 cm., or about 2 inches, thus exposing the lower segment.

*Step IV.* The upper parietal peritoneum is now doubly sutured to the upper portion of the visceral peritoneal flap, using a No. 1. chromic intestinal suture. This suture starts from one end of the peritoneum and is carried to the opposite side. A reinforcing suture with invagination of the peritoneum is now applied. The lower edges of parietal and

visceral peritoneum are sutured in the same manner, and are joined at either end to the first line of suture, thus entirely shutting off the abdominal cavity. A Doyen retractor is placed in the lower angle of the wound and the lower segment is exposed. A strip of two-inch iodoform gauze is placed across the upper sutured layer of peritoneum to protect this area from the excess of the uterine spill.

*Step V.* A small transverse incision is made in the lower segment and the suction tube is introduced, removing as much amniotic fluid as possible. The incision is now enlarged transversely by means of bandage scissors, gently curving the incision upwards at either end, while T clamps are applied as the incision is made. A small vertical incision at the midpoint of the transverse incision will give added room if necessary. As the incision is made, 5 c.c. of pituitrin is injected into the uterus, and a hypodermic of ergotrate is given intramuscularly.

The child is delivered by inserting the hand carefully under the lower flap and raising the presenting part, at the same time exerting pressure on the fundus. The blade of a forcep used as a shoehorn will also aid the delivery, as will the application of small forceps. The placenta will generally become detached as the uterus contracts.

Two Kocher forceps placed at either angle of the wound will insure proper approximation of the edges. Interrupted sutures are placed and second row of continuous No. 2 chromic is added.

Drainage of the retrovesicular area is optional, but, if desired, it may be established according to the method suggested by De Lee or that of Aldridge in his modified Latzko operation. A small cigarette drain is placed between the bladder and the lower uterine segment. This drain passes out through the midportion of the uterine incision where it is sutured by No. 0 catgut. The lower end is carried out into the vagina. It is allowed to remain for seven days and is removed through the vagina.

*Step VI.* The lower reflected flap of the sutured visceral parietal peritoneum is now carried up and sutured to the upper wound.

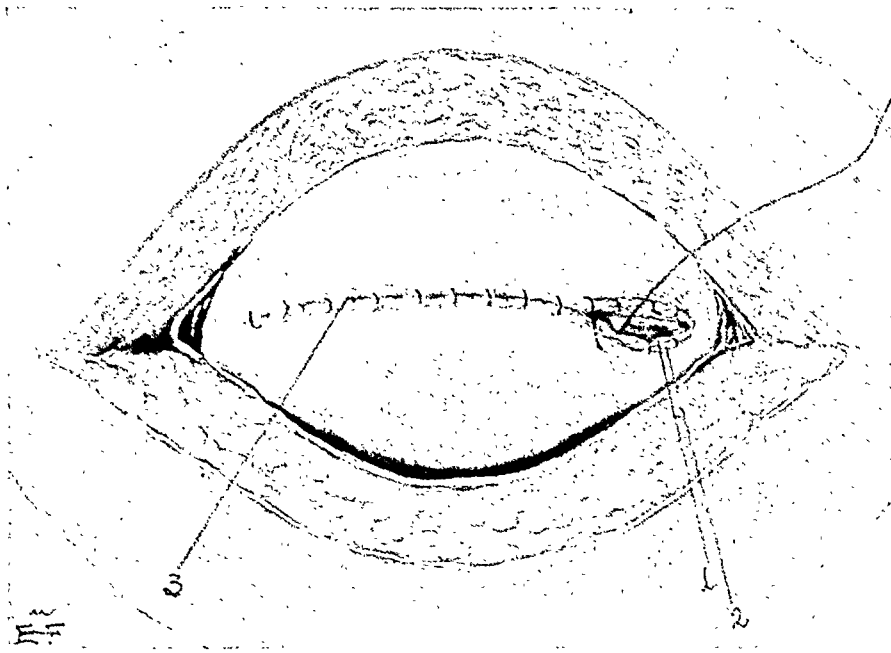


FIG. 4. 1 and 2, Sutured layers of vesical and parietal peritoneum. 3, Closure of united vesical and parietal layers.

united visceral parietal layer, by a few interrupted catgut sutures.

*Step VII.* The muscles are now allowed to fall together in the midline and may be approximated by one or two loose catgut sutures. The fascia is grasped at either end by skin hooks or Kocher artery forceps and a running No. 3 kaldermic suture is started through the skin at one end and carried through the fascia as a running mattress suture, emerging at the opposite end from the skin. When this suture is pulled taut, it snugly approximates the fascial edges. A similar suture is placed starting through the skin as before, but below the first. This includes the superficial fascia and again emerges from the skin below the point of the first emerging suture. After the skin is closed, the two suture ends at either end of the wound are tied over a gauze roll. The sutures are removed by cutting both at one end, iodinating them and drawing them out twelve days later. It is better to cut them on the tenth day, and remove them on the twelfth day. The sutures may also be cut off at either end, allowing the ends

#### CONCLUSIONS

The potentially or actually infected case must have an operation which will exclude the peritoneal cavity.

Such an operation is described. It not only excludes the peritoneal cavity, but gives the advantages of the transverse cervical or low segment operation.

The transverse cervical operation may be converted into a peritoneal exclusion operation without a necessary change of technique.

This operation provides for the natural point of drainage, that is, into the vaginal canal.

The operation lends itself to local anesthesia if desired.

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PAIN caused by moving the cervix, even slightly, with the examining fingers is common in ectopic pregnancy and to a lesser extent this symptom may be elicited in parametritis and cellulitis.

From—"Diseases of Women" by Paul Titus (National Medical Book Co.).

# INTRAVENOUS ANESTHESIA IN OBSTETRICS

## A COMPARATIVE STUDY OF PENTOTHAL AND EVIPAL SOLUBLE WITH A REPORT OF 250 CASES

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THE patent advantages of intravenous anesthesia in certain restricted surgical fields has been adequately presented in the world literature. The paramount, demanded characteristic of any anesthetic agent is safety, and recent advances in the preparation of certain barbiturates have endowed intravenous anesthetic drugs with a wide margin of safety. The wide usage of evipal soluble and the careful studies of large series of cases in which it has been employed indicate that in proper hands, properly administered, it is as safe an anesthetic as is known. Pentothal, an agent more recently developed than evipal, is stimulating similar reports in the literature and it, too, is gaining wider employment. Our interest in these drugs was aroused by the possibility of finding in them a more satisfactory anesthetic agent to be used obstetrically. We have previously reported an experience with evipal in both operative and spontaneous delivery. Since the appearance of that report we have continued our studies, enlarging our series of cases to about 250, equally divided between evipal soluble and pentothal. We have had an opportunity of making accurate, clinical comparisons between the drugs and the information gleaned from such comparison is here included.

Chemically and pharmacologically pentothal and evipal present similarities. Both drugs are rapidly destroyed in the body, probably by the liver. This fact points out a contraindication, namely, liver disease, and in obstetrics the toxemias of pregnancy and sepsis. Neither drug affects blood chemistry, with the exception of some

practically negligible elevation of blood sugar. Blood pictures are unaltered. Metabolism is not affected. With anesthetic doses both drugs will produce a moderate respiratory depression which is not alarming and which will not produce clinical signs of anoxemia. The vasomotor effects of the drugs are at marked variance. Evipal almost invariably brings about an increase in pulse rate and a fall in blood pressure, while pentothal, almost as consistently, will effect an elevation of pressure and will leave the pulse rate unaffected or somewhat slowed. Other pharmacologic characteristics have no clinical bearing.

Pentothal and evipal are powders, and both are sodium salts and readily soluble in water. The drugs are prepared in ampoules containing 1 Gm. Pentothal is best dissolved in 20 c.c. of water, giving a 5 per cent solution, while evipal is dissolved in 10 c.c. of water, producing a 10 per cent solution. The evipal as prepared for use is colorless and clear, while pentothal is a yellow tinged solution, similarly clear. When the solutions have been prepared, turbidity contraindicates their use and fresh solutions must be resorted to. The dosage (advised maximum) is 1 Gm. of the crystals.

Administration is by vein, preferably one of the vessels in the cubital fossa. Injection should be slow. We have repeatedly found that 4 to 5 c.c. of either drug produces surgical anesthesia. Because of the vasomotor reaction to evipal, it is advisable to inject more slowly than with pentothal. Thus anesthesia should be reached with evipal in sixty to ninety seconds while pentothal safely attains the same stage in

thirty to forty-five seconds. The depth of anesthesia is not a corollary of larger dosage. Maximum anesthetic depth is

general condition, hemorrhage, race, etc. Chart 1 graphically illustrates this point. There is marked individual susceptibility

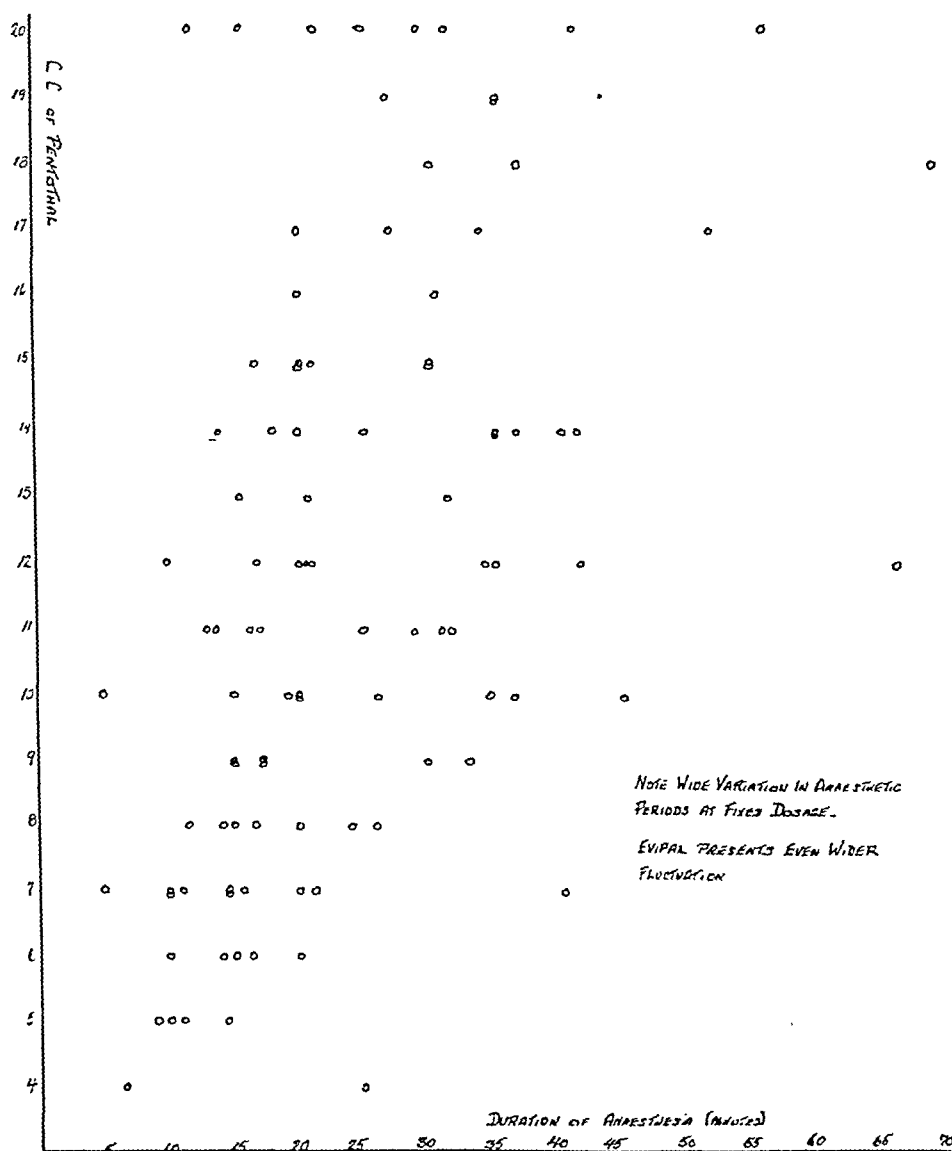


CHART 1.

reached with the doses noted and further administration of the drug merely serves to prolong the anesthetic stage. The anesthetist, therefore, injects the agent until surgical anesthesia is reached; then maintains his needle in position in the vein until signs indicate further injection.

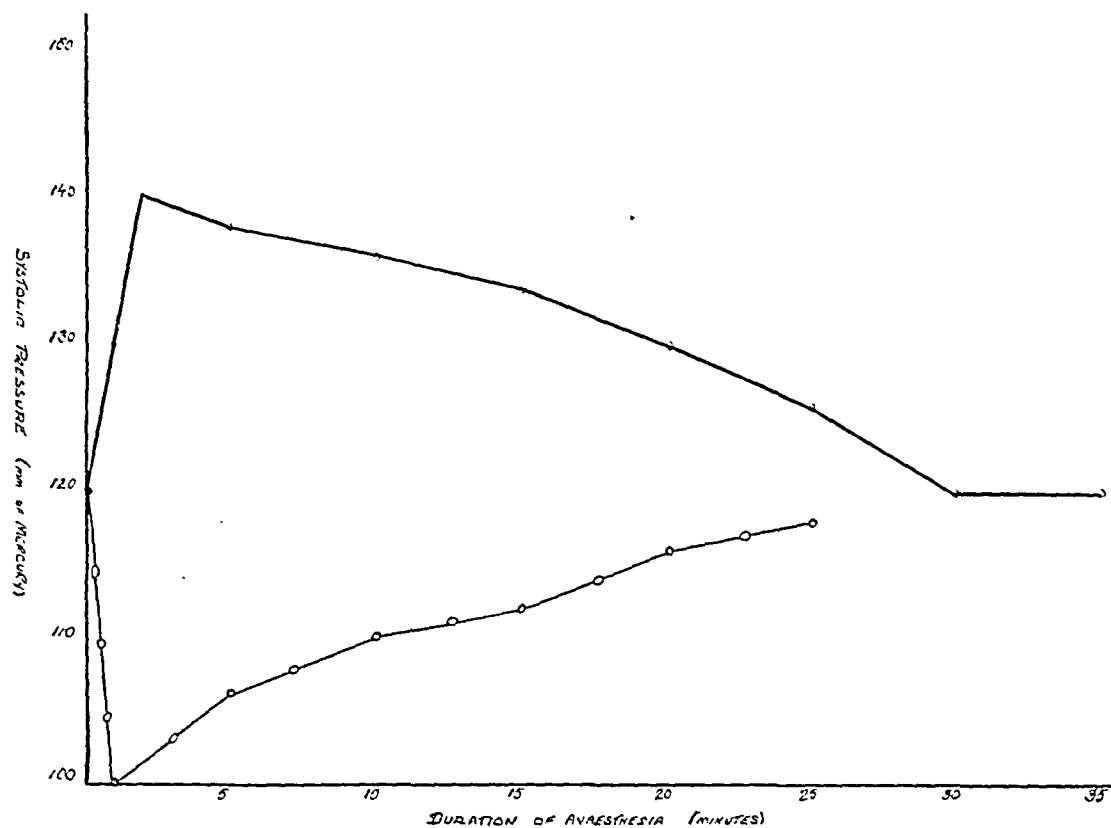
The duration of anesthesia at given dosages is extremely variable. We have been unable to fix any relationship between duration and such factors as age, weight,

to the action of the drugs and this must ever be in the mind of the anesthetist. It should be a fast rule to proceed on the smallest possible dosage. This will assure the widest possible factor of safety.

Induction of anesthesia with pentothal or evipal is a quiet event. Excitation is unknown. This is particularly true of pentothal, which has eliminated even the muscle spasms and twitchings so commonly seen in evipal induction. An incredibly

brief time after injection of either drug, the patient is surgically anesthetized. Under anesthesia, the patient exhibits variations

oscillation until the anesthetic begins to wear off. Under both drugs the lid reflex is completely obliterated.



AVERAGE RESPONSE OF SYSTOLIC PRESSURE  
UNDER PENTOTHAL AND EVIPAL ANAESTHESIA

CHART II.

when the two drugs are compared. The vasomotor effects have been stated and charts 2 and 3 illustrate these. Pentothal has a great advantage in its vasomotor action. Both drugs depress respiration, but in our experience, respiration is audible and stertorous in 50 per cent of cases anesthetized with pentothal. We have never heard the respiration when using evipal. Certain observers have suggested placing a wisp of cotton over lips and nose to be used as a guide to the character of the breathing. We have never found this essential.

Eye signs differ under the two drugs. Chief variation is in the pupil. Evipal always causes wide pupillary dilatation while pentothal rarely causes more than mid-dilatation. Both drugs fix the eye in mid-position where it remains without

In the obstetrical field there are common advantages. The speed of induction, the ease of administration, and the fact that preparation of the patient for anesthesia is unnecessary, are common to both drugs. Over a series of 250 cases, neither has produced respiratory difficulty or asphyxia in the newborn. We have never seen the case in which either drug could be held responsible for post-partum hemorrhage. Uterine contractility and uterine contractions are not impaired by either drug. Pentothal will, in approximately 60 per cent of cases, efface the bearing down efforts. This is a disadvantage in spontaneous deliveries. In operative deliveries it may serve as an advantage to some operators, while to others it might be objectionable. Evipal has no affect on bearing down efforts.



TABLE I  
COMPARATIVE ANALYSIS OF PENTOTHAL AND EVIPAL SOLUBLE  
(Based on a comparative series of 250 cases)

	Pentothal	Evipal Soluble
Chemistry.	Sodium salt of ethyl (1-methyl butyl) thiobarbiturate.	N-methyl-cyclohexenyl-methyl-malonyl-urea (sodium salt).
Preparation.	1 Gm. of crystals dissolved in 20 c.c. of distilled water. Solutions must be fresh.	1 Gm. of crystals dissolved in 10 c.c. of distilled water. Solutions must be fresh.
Administration.	Intravenous: No more than 4-5 c.c. in thirty seconds to induce anesthesia. When surgical anesthesia is attained further injection is performed as indicated by the status of the patient.	Intravenous: 4-5 c.c. in 60-90 seconds to induce anesthesia. When surgical anesthesia is attained, further injection is performed as indicated by the status of the patient.
Speed of anesthetization (Surgical).	30-45 seconds without danger.	60-90 seconds without danger.
Duration of anesthesia.	Variable: maximum in this series with a 1 Gm. dose: 68 minutes. No relation of dose to duration in the individual patient. Average duration, doses from 4-20 c.c.—23 min.	Variable: maximum in this series with 1 Gm. dose: 25 minutes. No relation of dose to duration in the individual patient. Average duration, doses 3.5-10 c.c. 12 min.
Maternal effects		
(a) Blood pressure.	Most commonly a moderate rise of pressure with a gradual return to normal. More rarely the pressure is unaffected or exhibits a fall of no more than 5-10 mm., with rapid return to normal.	Commonly a fall varying from 15 to 20 mm. with a gradual return to normal. More rarely the pressure remains level. In this series no pressure elevation was seen.
(b) Pulse.	Commonly remains unaffected or is slowed. Rarely increased in rate.	Usual rate increase with return to normal with cessation of anesthesia.
(c) Eye signs.	Eye is fixed in mid-position with lid lag marked. Pupil rarely at or beyond mid-dilatation.	Identical with pentothal except pupil which commonly is widely dilated.
(d) Respiration.		Depressed moderately in depth. Rate of respiration unaffected.
(e) Uterine contractions and contractility.	Respiration audible in 50 per cent of cases. Unaffected.	Respiration generally inaudible. Unaffected.
(f) Bearing down "reflex."	Obliterated in 60 per cent of the cases.	Unaffected.
(g) Hemorrhage.	No tendency toward production of increased bleeding in the third stage.	No tendency toward the production of increased bleeding in the third stage.
Fetal effects.	No apparent effect in the fetus. Respiratory difficulty not encountered.	No apparent effect in the fetus. Respiratory difficulty not encountered.
Induction.	Rapid; uncomplicated; no excitation; no muscle spasm.	Rapid; uncomplicated; generalized or localized muscle spasm is common.
Recovery.	Rapid. "Hangover" common hence patients may remain drowsy for two to three hours.	Rapid. Clarity generally present in one hour. Occasional persistent drowsiness.
Post-anesthetic complications.	Rare; vomiting unusual.	Rare; vomiting unusual.
Urinary or blood reactions.	None.	None.
Obstetric contraindications.	Toxemia. Version. Sepsis.	Sepsis. Toxemia. Version. Any procedure which may require an anesthetic period exceeding 20 minutes.
Pharmacology.	From the practical viewpoint pharmacologic characteristics are identical. There is some variation in the lethal dosage in the experimental animal. Both drugs are rapidly destroyed, probably by the liver. Both drugs produce death by respiratory depression and arrest. Neither depresses metabolism, temperature, alkali reserve or blood sugar.	
Denarcotization.	Rapidly accomplished by use of metrazol or coramine.	Rapidly accomplished by use of metrazol or coramine.
Respiratory depression or cessation.	Artificial respiration; carbon dioxide and oxygen; picrotoxin; coramine; metrazol.	Artificial respiration; carbon dioxide and oxygen; coramine; metrazol.

Variation in duration of anesthesia has been mentioned. Evipal will produce, at the maximum, twenty-five minutes of anesthesia. We have seen one case in which a single dose of pentothal gave an anesthetic period of sixty-eight minutes. The duration of anesthesia is always longer with pentothal which is a tremendous advantage. To exceed the normal maximum anesthesia with evipal implies multiple dosage. We cannot advise the use of more than 1 Gm. of evipal, as dosages exceeding 1 Gm. limit the margin of safety. When the normal dose of evipal is exhausted the operator is safer supplementing with an inhalation anesthetic or by local infiltration. This will rarely, if ever, be necessary when pentothal is used.

TABLE II  
OBSTETRIC PROCEDURES PERFORMED UNDER  
INTRAVENOUS ANESTHESIA  
(Pentothal and Evipal)

Low Forceps (including episiotomy and repair, or repair of lacerations of first or second degree)
Mid Forceps (Mid-A, Mid-B, Kielland rotation, Scanlon maneuver, manual rotation)
Breech Extraction (delivery of the after-coming head by Piper forceps, Smellie-Veit maneuver, Martin-Wiegand maneuver)
Examination under narcosis
Dilatation and curettage
Manual removal of the placenta
Packing of uterus and vagina
Spontaneous delivery
Procedures Attempted Without Success
Version
Cesarean section

In our earlier work with evipal it was our custom to place the patient on the table, cleanse the obstetrical field, catheterize, and examine obstetrically before proceeding with the injection. This was essential to completion of procedures under evipal. The short action of the drug made it necessary to spare no effort to conserve time. Pentothal obviates this. The procedures required may be performed at a more leisurely pace after the patient is anesthetized. Thus the injection is begun, and preparation, catheterization and examination follow. The operative procedure is then started.

The comparative table (Table I) was derived from data collected from 250 operative deliveries. In addition to operative procedures we have used these drugs as indicated in Table II.

Of our series of 250 operative deliveries certain facts may be quoted: the oldest patient was 39, the youngest 15. Ninety-seven per cent of the patients were colored. The pentothal cases, where there was no technical difficulty in injection, never required supplementary anesthesia. Evipal required supplement in 15 per cent of the cases. There was no maternal or fetal mortality due to the drugs. One fetal death occurred following impaction of the shoulders, requiring the use of the Braun hook for completion of the delivery. Seventy-four per cent of the patients were primiparae. In the group, low forceps and episiotomy and repair were the commonest procedures. There were no post-anesthetic complications. Vomiting was seen rarely, and the cases in which it occurred more commonly were anesthetized with evipal. The average duration of anesthesia under pentothal was twenty-three minutes, under evipal twelve minutes. Recovery was more rapid with evipal. Pentothal left the patients drowsy for from one to three hours. Certain operators might consider this advantageous. In no instance was any great difficulty in resuscitation of the newborn encountered. In no case were alarming signs noted in the mothers. Post-partum hemorrhage occurred four times. Three of the cases were under evipal, but we hold this to be coincidental. Neither drug inhibits uterine contractility. The series included one decompensated rheumatic cardiac, one severe pyelitis and one status asthmaticus. In this last case we ruled respiratory difficulty from our list of contraindications.

We have never been able to perform cesarean section under these drugs. We have met with failure each time we have attempted version. We cannot obtain adequate relaxation for either procedure. Various operators have had no difficulty

with abdominal procedures under intravenous anesthesia. In our hands it has failed.

and oxygen have a similar effect, and these agents should be employed in the event of respiratory collapse. Artificial respiration



CHART III.

Intravenous anesthesia carries tremendous advantages for the obstetrical operator; we have previously detailed these findings. After our experiences with both drugs we consider pentothal to be the superior agent, by virtue of its more salutary affect on the vasomotor system, its more prolonged action, and its tendency to permit the occurrence of audible respiration.

While we have never seen alarming symptoms or signs in an anesthetized patient, we have found that denarcotization may be rapidly accomplished by the intravenous administration of coramine or metrazol. These drugs should be used in doses of from 3 to 5 c.c. Carbon dioxide

is, of course, indispensable. From our observations we feel certain that proper administration and proper dosage, in cases presenting no contraindications, will never result in difficulty.

General contraindications to pentothal and evipal are similar: liver disease, sepsis, debility, etc. Obstetrically the drugs are contraindicated for version and in toxemias (the rôle of the liver in the toxemias must be remembered). Unless the operator desires to supplement anesthesia, evipal is contraindicated where it is expected that the operative procedure may exceed twenty or twenty-five minutes. Analgesia produced by the usual agents employed (nembutal, scopolamine, morphine, ether-in-oil, paral-

dehyde, etc.) does not contraindicate the use of evipal or pentothal. We have used pentothal for delivery in cases in which analgesia was produced with doses of nembutal up to 9 gr. We have used pentothal where nembutal and paraldehyde by rectum had been used. No ill effects have been seen.

#### CONCLUSIONS

1. Pentothal and evipal have been used in a series of 250 obstetric operative procedures.
2. The characteristics of the drugs are recorded.
3. Pentothal has been found to be free of depressant action on the vasomotor system.
4. Pentothal produces more prolonged anesthetic periods in doses equal to those of evipal.

5. Obstetrically, where an intravenous anesthetic is to be employed, pentothal is the agent of choice.

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# THE SURGICAL TREATMENT OF SYRINGOMYELIA\*

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BY advocating operative interference for syringomyelia, Frazier,<sup>11</sup> in 1930, stimulated renewed interest in the therapeutic possibilities of this distressing condition. This was followed in 1931 by the work of Putnam and Munro<sup>35</sup> who added a series of four cases of syringomyelia treated by myelotomy, together with an excellent review of the subject as developed by the pioneer workers in this field, notably Poussepp and his associates.

That syringomyelia was amenable to surgical interference had been suspected even before Poussepp's initial report in 1926. The classic monograph by Guy Hinsdale,<sup>3</sup> which received the Alvarenga Prize of the College of Physicians of Philadelphia for the year 1895, contained a bibliography of 514 references with only one article indicating a possible therapeutic approach from the standpoint of surgery. This reference was a case report by Abbe and Coley<sup>1</sup> in which a patient with syringomyelia was operated upon, laminectomy performed, and a suspected cyst evacuated, with improvement in the patient's clinical condition. This report has been largely overlooked and sufficient credit has never been given to these early workers who, indeed, displayed extreme courage at a time when spinal cord surgery was still in its infancy. No further surgical treatment for syringomyelia is to be found in the literature until 1916, when Elsberg<sup>8</sup> operated upon a suspected spinal cord tumor and evacuated a syringomyelic cavity. This case is one of the interesting reports in the latter's monumental work on spinal cord tumors and no doubt stimulated further interest in this subject. Hassin<sup>18</sup>

and Collier<sup>3</sup> both mentioned cases with operative interference in 1920 and 1921, but little note was made of the outcome of these cases. Individual cases were operated on by Sharpe<sup>41</sup> in 1917 and by Christophe<sup>2</sup> in 1922, but their observations were not recorded until after 1926.

At a meeting of the International Neurological Congress in Paris in 1926, the first report of Poussepp<sup>36</sup> was received with great interest. He gave in detail the results of operation in two cases of syringomyelia. The cervical spinal cord in each instance was incised, the cystic cavity revealed, and fluid released under pressure. Progressive clinical improvement followed and continued for some time. Several additional cases were discussed fully in a later publication by the same author.<sup>37</sup> Within six years after Poussepp's reports, the literature contained some fifty cases of syringomyelia with operative interference, which were carefully compiled and analyzed in 1932 by Schaeffer.<sup>39</sup> This review showed relative improvement in all the cases surgically treated, with only six cases definitely aggravated by interference. The studies tabulated by Schaeffer indicate the interest shown in the continental clinics, only some thirty cases being found in the American literature to date.

The entire subject of the surgical treatment of syringomyelia was very ably reviewed in 1931 by Ssosan-Jaroschewitsch.<sup>42</sup> He distinguished, perhaps for the first time, between the "dry" form with an extremely poor prognosis, and the "hydropic" or "wet" form with increased pressure and subarachnoid block, in which there was a comparatively good prognosis. This care-

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ful differentiation provides one of the necessary criteria upon which to base surgical intervention, since in the majority of cases treated, the maximum of benefit derived has been seen in those with large cystic cavities under increased pressure. The majority of these so-called "hydropic" cases have revealed either a partial or fairly complete subarachnoid block.

Peiper<sup>33</sup> during the same year reviewed the results of sixteen authors with a total of forty-four operations. Five cases showed remarkable improvement, with good results in twenty-one. Additional reports on this subject have been made by Sicard,<sup>43</sup> Vitek,<sup>44</sup> Zeno and Cames,<sup>45</sup> Oppel,<sup>31</sup> Foerster,<sup>9</sup> Peiper,<sup>32</sup> Schmieden,<sup>40</sup> Guleke,<sup>16</sup> Lafora,<sup>24</sup> Kappis,<sup>22</sup> Juzelewski,<sup>21</sup> Cooper,<sup>3</sup> and more recently by Gorsky,<sup>14</sup> Ellmer,<sup>7</sup> and Kuttner.<sup>23</sup> Six deaths have been reported by these investigators, but the majority of the individual reports are favorable, and the wide experience of Juzelewski<sup>21</sup> includes fifteen cases benefited by operation. Davis<sup>5</sup> and Mixer<sup>26</sup> have recently mentioned their experiences with surgical intervention in cases of syringomyelia, and though some of their patients have been able to return to their work, both of these observers are quite conservative in their estimate of the value of interference, and have not reported their cases in great detail.

The latest and most complete review of the subject has been made by Ley,<sup>25</sup> who has carefully analyzed some eighty-eight cases found in the literature and has added four cases of his own. This study includes the post-operative results known in seventy-eight cases. The immediate results were 68.9 per cent improved, 12.9 per cent unimproved, and 18.2 per cent definitely aggravated by operative interference. These figures compare favorably with those of Delherm and Morel-Kahn,<sup>33</sup> who in a summary of ninety-one cases of syringomyelia treated by deep x-ray therapy alone, found 70 per cent of the cases improved. However, as Schaeffer<sup>39</sup> has observed, many cases have been little influenced by x-ray, and Christophe<sup>2</sup> has found some

even aggravated by this type of treatment, possibly due to the edema produced by irradiation.

Clinical improvement following surgical intervention has generally been noted by return of sensation, particularly in the upper extremities, improvement in the trophic disturbances, relief of pain, and a marked decrease in the amount of spasticity. No patient has been cured by intervention, but the majority have been improved and in some cases have been able to return to their former occupations.

#### REPORT OF CASES

CASE 1. F. C., a white female 36 years of age, was admitted to the surgical service of the Hollywood Hospital on March 10, 1933 for observation. The patient had been a dancer in her earlier years and very successful in her profession.

In December 1920, she became conscious of a gradual and progressive weakness of the right arm and hand. She made the rounds of the several neurologic clinics where many and varied diagnoses were made, including tumor of the spinal cord and syringomyelia. In July 1925, the patient entered the Neurological Institute of New York where she was carefully examined. The objective findings at that time included marked weakness of the right hand and arm, some atrophy of both sternomastoid muscles, considerable curvature of the spine in the upper thoracic region, and greatly exaggerated reflexes. A study of the spinal fluid hydrodynamics revealed a clear fluid under low pressure; the impression was that of a partial cerebrospinal fluid block. The diagnosis of syringomyelia was made and the patient was given repeated courses of deep Roentgen ray therapy. She did fairly well for a considerable period of time, but early in 1933 there was noticed a rapid and progressive weakness of the right leg, accompanied by a peculiar sensation of numbness in the fingers of the right hand; in fact, the patient had several times picked up a hot curling iron and was surprised that she suffered a burn without feeling it.

*Neurologic Examination.* There was marked atrophy of the entire musculature, and the patient weighed 110 pounds. The right hand and arm were rigid and contracted, and the gait was of the right hemiplegic type. Right

ankle clonus and Babinski sign were present, as were bilateral Gordon and Oppenheim signs. The abdominal reflexes were not elicited. Sensation to pin-prick was excellent, but posi-

*Diagnosis.* Syringomyelia of the cervical spinal cord with subarachnoid block. Since no relief was afforded by intensive deep Roentgen ray therapy, operation was advised.

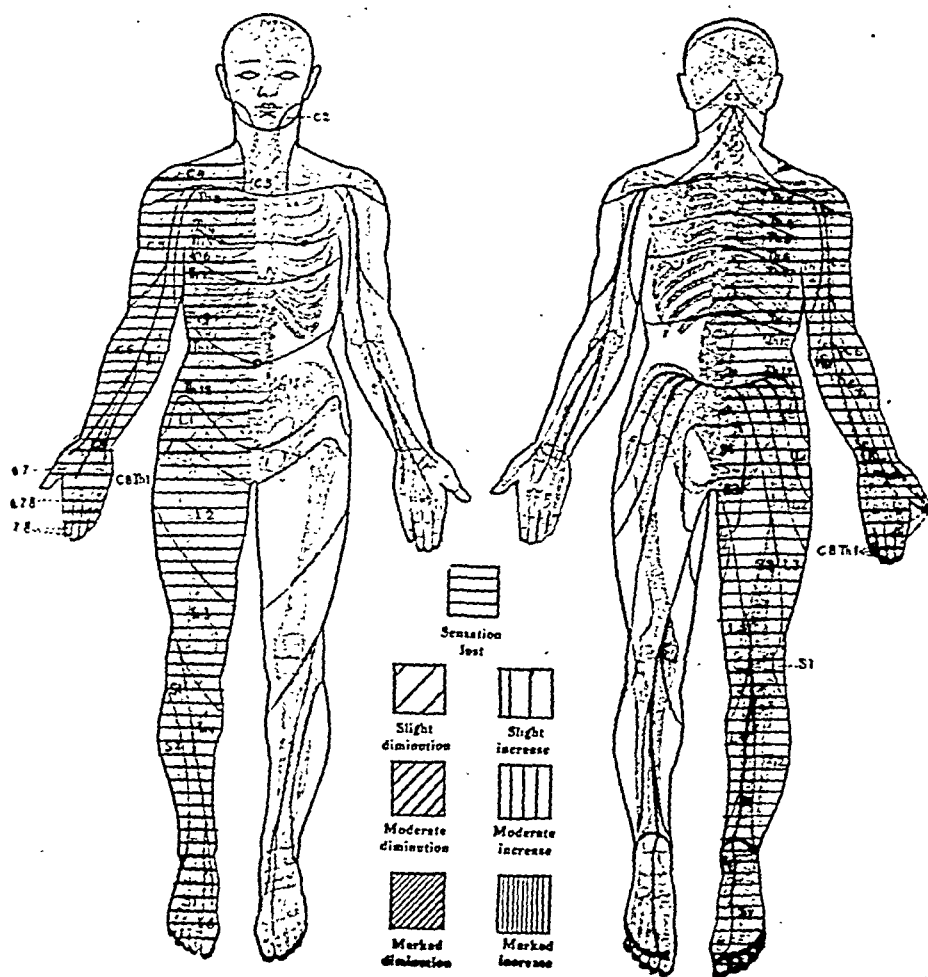


FIG. 1. Case 1. Marked disassociation of pain and temperature—loss of sensation of hot and cold on right side of body.

tion sense was markedly impaired, particularly on the right side. There was marked disassociation of pain and temperature, the patient being unable to differentiate hot or cold on the right side of the body with the exception of the face. Pain in the right arm and hand was quite severe. (Fig. 1.)

*Laboratory Findings.* The regular blood and urine examinations were normal, and the blood and spinal fluid Wassermann reactions were negative. A study of the spinal fluid hydrodynamics revealed a marked subarachnoid block with an increased protein content and two cells.

*Operation.* Under ethylene anesthesia an incision was made over the spinous processes of the fifth cervical to the first dorsal vertebrae and laminectomy carried out, removing the laminae widely on both sides. The dura was found to be under some increased tension and covered by an extremely small amount of extradural fat. The spinal canal, as such, was greatly widened, perhaps one and one-half times the normal size. The dura was opened by a longitudinal incision revealing a markedly distended spinal cord covered by an extremely adherent arachnoid. Upon gentle palpation the cord at the level of the fifth cervical vertebra

had a distinctly cystic feel, and upon wide reflect of the dura, a large cyst was discovered, having a surface extension on the right side

progression of symptoms in her case. She is able, at this time, to continue with many of the duties of a housewife. Pain in the right

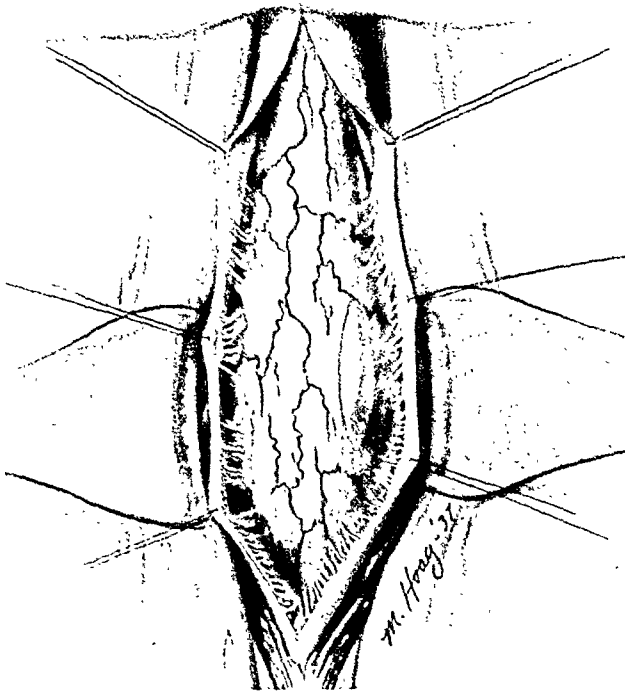


FIG. 2. Case 1. Cervical spinal cord showing cystic enlargement with surface extension.

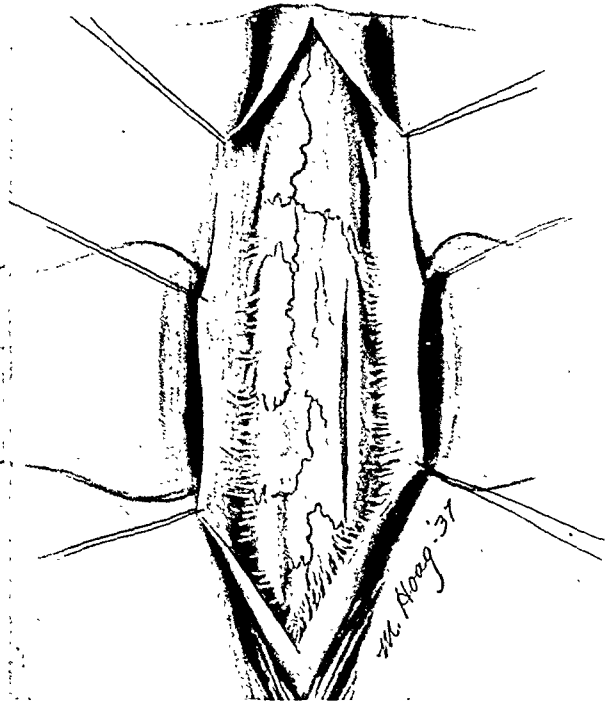


FIG. 3. Case 1. Cervical spinal cord following drainage of cystic cavity.

of the cord. (Fig. 2.) A hypodermic needle attached to a small syringe was introduced into the cystic cavity, evacuating at once a large amount of clear, colorless fluid, approximately 20 c.c. of which was removed by a gentle aspiration. The spinal cord immediately began to shrink in size; after the withdrawal of the fluid, the cord had the appearance of a deflated balloon. (Fig. 3.) A large number of arachnoid adhesions was found; these were attributed to the intensive x-ray treatment previously given. The spinal cord was gently split throughout the length of the cystic cavity. The dura was then very loosely closed with three silk sutures, and the wound was closed in the usual manner with black silk.

The post-operative period was most uneventful. The patient felt very comfortable following the operation and was discharged from the hospital within two weeks with increased strength in the right upper extremity. Pain was practically absent and the fingers of the right hand could be moved with considerable freedom.

The patient has been examined every few months since the time of her operation until the present date, and there has been no definite

upper extremity is absent, and the fingers of the right hand have recovered a considerable amount of strength. The gait is still of a hemiplegic type and the right forearm and shoulder are still quite rigid and spastic. There is a fairly definite right Babinski sign and ankle clonus. The sphincters have never been involved. It is felt that operative interference in this case has been of some benefit and, while it is still too early to become enthusiastic about the future of this patient, she will be carefully observed for any new developments.

*Comment.* This case represents an interesting study in retrospect, particularly in the light of recent observations made on secondarily operated cases. The problem in this case was greatly simplified since the intramedullary cyst had a definite surface extension, eliminating at once, a more or less blind puncture of the central canal as advocated by Poussepp. It was definitely recognized at the operation that the lips of the incision into this cystic cavity would probably be sealed over in the process of wound-healing. The twice



operated cases, notably those of Frazier,<sup>11</sup> Poussepp<sup>37</sup> and Ssosan-Jaroschewitsch,<sup>12</sup> have all shown a closure of the original

Mucenicks;<sup>25</sup> Ellmer,<sup>7</sup> Poussepp,<sup>37</sup> and Schaeffer<sup>29</sup> have used muscle for the same purpose; Gardner<sup>12</sup> has used silver clips

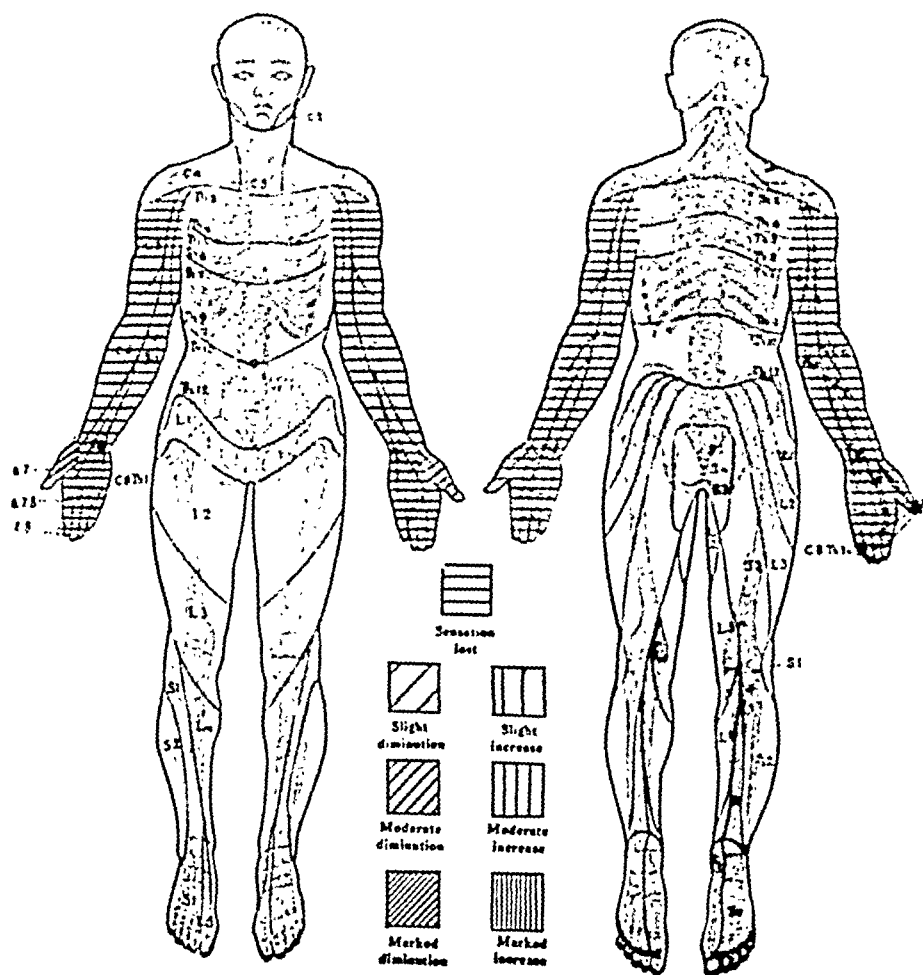


FIG. 4. Case 11. Loss of sensation of hot and cold before operation. Pin prick about equally affected below the elbows.

opening in the spinal cord with a plastic arachnoiditis. In Frazier's case, he attempted at the first operation to insert a thin slip of gutta-percha between the lips of the incision in the cord. Exploration some three years later disclosed the incision healed and closed over, and the gutta-percha drain at the bottom of the cystic cavity. At this session Frazier secured the strip of gutta-percha by clamping it to the ridge of the cordotomy wound with a silver clip. Others, with the object of assuring thorough drainage, have used a small piece of dura inserted in the incision, such as

about the lips of the incision, and Mixer,<sup>26</sup> in two cases, has sutured the lining membrane of the cavity to the arachnoid of each side. The dura no doubt is best left open to secure as much decompression as possible.

That simple laminectomy in itself may prove to be of value in relieving the symptoms of syringomyelia has been demonstrated by Guillain, Schmide and Bertrand.<sup>17</sup> Exploratory puncture of the spinal cord carries considerable risk in cases where the suspected cystic cavity is quite small or not under increased pressure. Our

second case of syringomyelia with surgical intervention disclosed a so-called "dry" type which was treated by nothing more

ness of both grips. He had been examined in the Out-Patient Clinic some three times before admission to the hospital and a tentative diag-

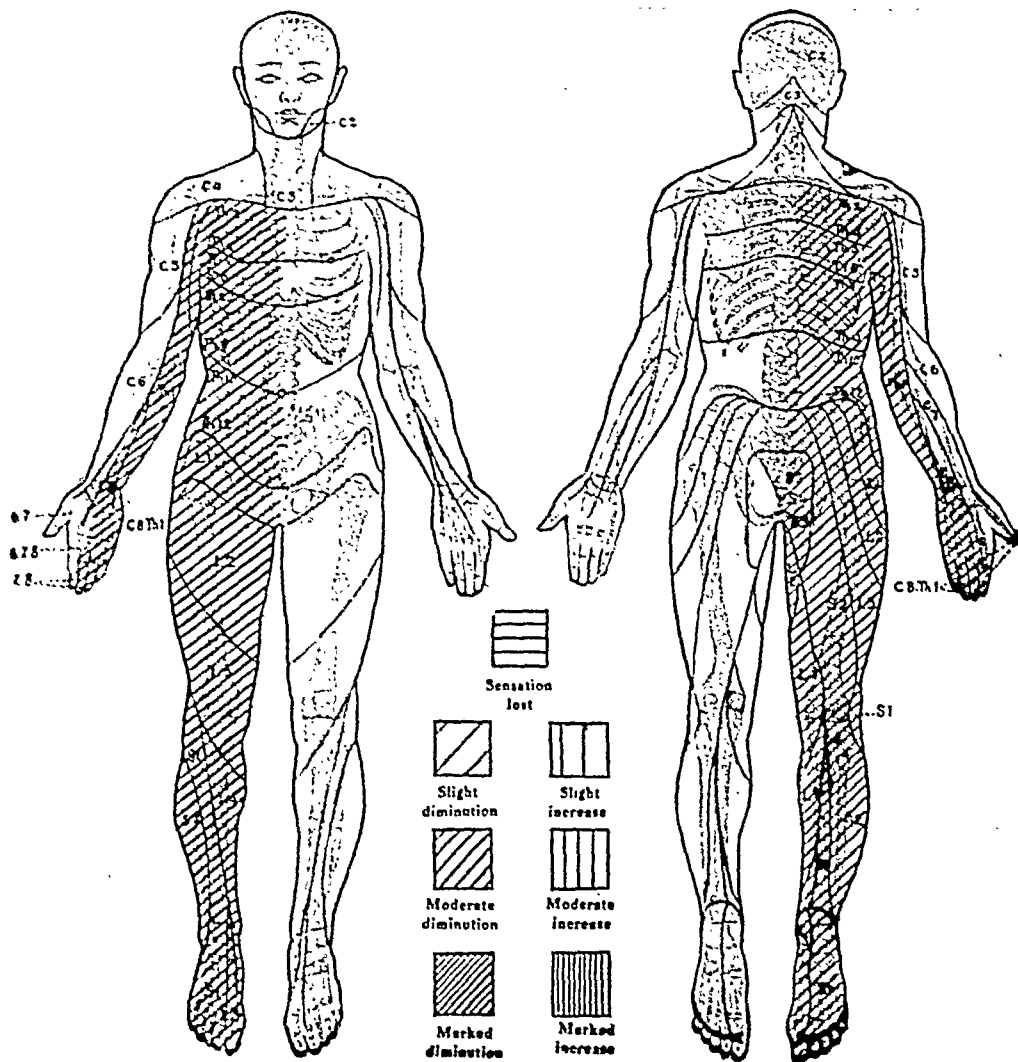


FIG. 5. Case III. Loss of sensation of hot and cold. Pin prick equally affected over the same area.

than a generous laminectomy, following the suggestion of the above authors, with rather interesting results to date.

**CASE II.** C. H., a white male laborer 36 years of age, was admitted to the Medical Service of the Los Angeles County General Hospital on September 26, 1933. He had considered himself well until January 15, 1933, at which time he caught a severe cold while at work. Shortly after recovering from this infection, he noticed that the lower extremities were very cold and that there were progressive sensory changes, beginning with tingling in the right hand. There was also pain in the right upper extremity with progressive marked weak-

nosis of syringomyelia was made. During the two months previous to the hospital admission, the palms of both hands had become so anesthetic that several burns were sustained of which the patient was unaware.

**Past History.** The patient had suffered many illnesses during his life, having had severe attacks of measles, yellow fever, malaria, typhoid fever, mumps, bronchopneumonia, and left otitis media, in each instance making an uneventful recovery.

**Neurologic Examination.** This revealed marked weakness of both hands with extreme atrophy. The grips in both hands were nil. The reflexes were markedly exaggerated and increased on the right side. There was an incon-

stant right Babinski sign. The palms of both hands showed a marked anesthesia, except for the thumbs, which were distinctly less affected. The patient was unable to differentiate hot or cold in either upper extremity. There appeared to be areas of hyperesthesia to pin prick about both elbows but not following any particular nerve distribution. Position sense in the right foot was practically lost. Pain in both shoulder girdles was rather constant and severe. (Fig. 4.)

*Laboratory Findings.* The blood and urine examinations were normal. A careful study of the spinal fluid hydrodynamics revealed a clear fluid with a pressure of 150 mm., and with no evidence of any subarachnoid block. The blood and spinal fluid Wassermann tests were negative.

*Diagnosis.* A diagnosis of syringomyelia of the cervical spinal cord was made and operation was recommended on account of the apparently rapid progress of the disease.

*Operation.* Under ether anesthesia an incision was made from the foramen magnum to the sixth cervical spinous process and laminectomy carried out, removing the laminae widely on both sides. There was no extradural fat and the bony tissues were particularly thin. The dura appeared to be under some slight increased tension, and upon opening the membrane, there were found multiple firm web-like arachnoid adhesions. The surface of the spinal cord appeared to be somewhat reddened and the vessels engorged. The extensive arachnoiditis appeared to be generalized throughout the entire length of the exposed spinal cord. The cord itself appeared to be somewhat smaller than what one would normally expect in this neighborhood and careful inspection did not reveal any cyst-like enlargements. It was not thought favorable to attempt to needle the central canal in an effort to locate a possible syringomyelic cavity. The dura was left open and the rest of the wound carefully closed in layers with black silk.

The post-operative period was quite satisfactory. There was almost complete relief of pain in the arms, and muscular strength in the hands began to return at a rapid rate. The patient was discharged to the Out-Patient Clinic for further observation, with the recommendation that he receive deep x-ray therapy to the cervical spinal cord should there be any recurrence of symptoms. He was observed for a number of months in the Out-Patient Clinic and exhibited a remarkable return of muscular

ability with particular reference to both grips. Pain entirely disappeared. After a year and a half of observation the patient failed to return to the hospital. This case has been more or less lost sight of since, but the end result at the time of this patient's disappearance was considered to be fairly satisfactory.

Our third case was treated in a similar fashion, that is, by simple laminectomy and generous decompression. While the post-operative result was remarkable for its immediate relief of symptoms and increase in muscular strength, there followed after a short six month period of remission a sharp recurrence of symptoms which to date have been only fairly well controlled with deep x-ray therapy.

CASE III. M. C., a white 38 year old housewife, was first seen on June 18, 1934, complaining of progressive muscular weakness of the left arm and leg with sensory disturbances in the right lower extremity. She stated that her present illness dated back about four and one-half years, at which time both hands became very weak. At this time she had a number of chiropractic adjustments. Following one of these treatments, she stated she was unable to use her arms or legs for a few minutes. In November 1932, the left ankle began to get weak and she dragged the left foot. At about the same time she complained of pain in the left shoulder and arm, with numbness of this extremity. During April 1933, the right leg began to feel numb, and in September 1933, she burned the right ankle with an electric pad and did not feel the pain, although a second degree burn was sustained. By June 1934, there was marked weakness of the left arm and leg with distinct loss of sensation in the right lower extremity.

*Neurologic Examination.* There was a definite left Horner's syndrome; also, marked weakness of the left arm and leg; left grip practically nil; left hemiplegic type of gait; no definite atrophy of the intrinsic muscles of the hand, forearm or arm on either side. A fairly typical Brown-Séquard type of disturbance was present, there being diminution of touch, pain and temperature on the right side up to about the first dorsal segment, with marked disassociation of pain and temperature senses on the right side. (Fig. 5.) There were several scars of healed burns on the right leg.

A bilateral Babinski sign, marked exaggeration of the knee jerks, absence of Gordon, Oppenheim or ankle clonus on either side, and positive Hoffman sign both right and left, completed the picture.

*Laboratory Findings.* Urine and blood examinations were normal. Blood and spinal fluid Wassermann reactions were negative. A careful study of the spinal fluid revealed a clear, colorless fluid with one cell and an initial pressure of 90 mm. of water. On bilateral compression of the jugular veins, the fluid slowly rose to 190 and then slowly dropped back to normal. This was interpreted as an incomplete block.

*Diagnosis.* Syringomyelia of the cervical spinal cord, with incomplete subarachnoid block was diagnosed. Operation was advised, since the patient was rapidly becoming very weak and the sensory disturbances were aggravated.

*Operation.* Under ethylene ether anesthesia, an incision was made from the atlas to the seventh cervical spinous process and laminectomy carried out in the usual manner. The bony structures were found to be very thin and friable and the spinal canal appeared to be greatly widened throughout the entire cervical area. The dura was under some increased tension and was opened with a longitudinal incision, revealing a grayish and thickened arachnoid with many fine adhesions. The posterior surface of the spinal cord was covered with greatly enlarged and tortuous vessels. No cyst-like appearance of the cord was discovered and it was not thought wise to attempt to explore the central canal in a blind effort to locate a possible cavity. The dura was left open and the wound closed in layers with black silk.

The post-operative course was highly satisfactory. The patient was discharged to her home on the fourteenth post-operative day, at which time there was increased strength in the left arm and leg. She remained quietly at home for the following month, during which time she found herself able to get about the house without aid, and at the end of two months was quite able to do some of the housework—something which she had not been able to do for the previous year. The tendency to a hemiplegic gait on the left side almost completely disappeared and there was a considerable improvement in sensation in the right lower extremity. Some three and a half months following operation the patient stated that she thought her

general condition to be excellent. She had gained some 15 pounds in weight, and was able to perform most of her work as a housewife. This improvement continued for almost six months following operative interference, when suddenly the patient noted that the left leg again began to drag and there was some pain in the right arm and leg. She also found that she was becoming markedly constipated and at times would have difficulty in controlling the bladder, resulting in incontinence or dribbling. Since there appeared to be a definite recurrence of the former trouble, the patient was subjected to deep x-ray therapy over the spinal cord in the cervical region with some improvement to date. She has received several courses of deep therapy and will be carefully observed for the effects of this treatment. While she was definitely benefited by laminectomy and decompression, it is our opinion that the early recurrence of symptoms speaks for an increased gliosis about the central canal which may respond to deep x-ray therapy.

A recent paper from Frazier's<sup>12</sup> clinic has encouraged secondary intervention in cases failing to improve or with subsequent relapse following surgery. This view is also held by Oppel and Mucenicks and in the light of their experiences appears to be fully justified. In Frazier's first case, there was a second operation some three years after the initial interference, with enough improvement to indicate the value of repeated drainage in certain selected instances.

#### DIAGNOSIS OF SYRINGOMYELIA

The familiar picture of the disassociation syndrome (Charcot), loss of pain and temperature sensibility with atrophy of the extremities, is too well known to require detailed description at this time. The literature concerning this interesting disease is voluminous and dates back almost 200 years since Margagni and Santorini<sup>27</sup> first observed and recorded the existence of an abnormal cavity in the spinal cord. Portal,<sup>34</sup> in 1800, and Rachetti,<sup>35</sup> in 1816, also noted this strange phenomenon which had excited the curiosity of anatomists in the seventeenth and eighteenth centuries.

The pathologic condition passed without a distinctive name until, in 1837, Ollivier<sup>30</sup> called the affection "syringomyelia," a name by which it has since been generally designated. Virchow then looked upon all cavities in the spinal cord as expansions of the normal central canal and termed the condition "hydromyelia." To date no etiologic factor in this disease has been definitely described, although a congenital basis has long been considered the immediate cause.

A careful study of the spinal fluid hydrodynamics has never been greatly stressed with the exception of such recent authors as Putnam and Ssosan-Jaroschewitsch. In several of the cases described by various authors, evidence of cerebrospinal fluid stasis has been discussed. The fluid itself may reveal nothing more than some slight increase in cells and protein content even with a well advanced spinal fluid block, and since this constitutes many times the direct indication for intervention, careful pressure studies should always be made. Ssosan-Jaroschewitsch has divided his cases into so-called "dry" and "wet" or "hydropic" types based mainly upon the appearance or absence of a subarachnoid block. He believes that the so-called "dry" form with no evidence of fluid stasis carries an extremely poor prognosis and should not be operated upon. This constitutes one of the most important indications for intervention since many cases showing improvement after surgery have been of the "wet" or "hydropic" type with either partial or a fairly complete subarachnoid block. The use of iodized oil for localization has been suggested by several investigators and has been carried out by Jirasek.<sup>20</sup>

#### SURGICAL CONSIDERATIONS

The nature of this disease makes every step in the handling of a given case a hazardous procedure. These patients, as a class, take inhalation anesthesia badly and no doubt are best treated with local anesthesia. In those patients who are given a general anesthetic, the intratracheal tech-

nique, as practiced by Guedel<sup>15</sup> and his associates, has proved very satisfactory in our hands and has caused no untoward complications.

The operation, after a generous laminectomy has been performed, consists in puncturing the suspected cavity site in the spinal cord in the midline (Poussepp) or an incision similarly in the midline (Putnam) or an incision a few millimeters lateral to the midline on the side of the greatest cord damage (Frazier). After the cavity has been opened, permanent drainage may be established by the use of dura (Mucenicks), silver clips (Gardner), muscle (Schaeffer), or suturing the lining membrane of the cavity to the arachnoid of each side (Mixer). The wound, if closed carefully with black silk throughout, tends to heal kindly. However, precautions should be taken to see that the edges of the wound are tightly secured with adhesive strapping and that the patient is not allowed to pull himself up or to either side for a matter of several weeks; otherwise, the wound edges may break open with danger of secondary infection. Since the operative site many times is located within an anesthetic zone, it is easy to see how such a wound might fail to heal properly.

#### EVALUATION OF SURGICAL RESULTS

It has been very difficult after reviewing the results of surgical intervention in approximately 120 cases, to gain a true perspective of the value of surgical therapy. As Frazier<sup>12</sup> has observed, there have not been enough available reports to indicate the late results of surgery, that is, of cases which have been observed for at least one year following operation. He was able to collect only some sixteen cases followed for a year or more after intervention. A review of Ley's work—(Table 1) indicates the paucity of properly observed cases. Nevertheless, the same criticism holds true for those cases which have been treated by deep x-ray therapy alone. The observation of Mixer<sup>31</sup> is probably correct, that in all cases of syringomyelia, improvement under

Roentgen ray therapy or by surgery is difficult to measure because any improvement gained is frequently temporary. erroneous impression from the reported cases may be obtained since it is very likely true that an equal number of failures

TABLE I  
REPORTED CASES OF SYRINGOMYELIA WITH SURGICAL INTERVENTION

	Num- ber of Cases	Worse	Not Im- proved	Im- proved	Much Im- proved	Time of Observation
Elsberg.....	3	..	..	3	..	over 6 months
Poussepp.....	7	1	..	6	..	2 to 7 years
Sicard.....	3	2	..	1	..	over 6 months
Van Gehuchten.....	1	1	..	..	..	4 years
Jirasek & Vitek.....	4	..	..	4	..	over 6 months
Zeno & Cames.....	1	..	..	1	..	over 6 months
Oppel.....	6	1	1	3	1	over 6 months
Foerster.....	1	..	..	..	1	2 years
Schmieden-Peiper.....	4	..	3	..	1	4 months to 2 years
Guleke.....	1	..	..	1	..	over 6 months
Lafora.....	1	..	1	..	..	4 months
Kappis.....	1	..	..	1	..	over 6 months
Juzelewski.....	15	..	..	15	..	over 6 months
Heymann.....	1	..	..	1	..	5 years
Cooper.....	1	..	1	..	..	over 6 months
Frazier.....	2	..	..	2	..	{ 1 case 4½ years 1 case 2 years
Putnam & Munro.....	4	1	1	2	..	1 case 1½ years
Girgolaw & Ssosan-Jaroschewitsch.....	2	1	..	1	..	1 case 1 yr. 4 months
Gorslij.....	1	..	..	1	..	over 6 months
Ssosan-Jaroschewitsch.....	4	..	..	4	..	over 6 months
Ellmer.....	1	..	..	1	..	1 year
Korcic.....	2	..	1	1	..	over 6 months
Moniz, Pinto & Lima.....	1	1	..	..	..	1 month
Diaz Gomez.....	2	..	1	1	..	over 6 months
Kuttner.....	1	..	..	1	..	over 6 months
Biolato.....	1	..	..	1	..	over 6 months
Mucenicks.....	2	..	..	2	..	over 1 year
Mixer.....	18	1	..	..	..	{ series collected since 1919 statistics not given
Bassoe.....	1	..	..	1	..	over 6 months
Gans & Suermondt.....	1	..	..	1	..	over 6 months
Gardner.....	2	..	1	1	..	over 6 months
Zeitlin (Quoted by Putnam & Munro).....	6	..	..	..	..	..
Sharpe.....	1	..	..	1	..	5 years
Hassin.....	1	..	..	1	..	over 6 months
Collier.....	3	1	..	2	..	over 6 months
Christophe.....	1	1	..	..	..	lived one month
Ley.....	4	..	..	..	..	..
Davis.....	6	Statistics not given				..
Adelstein.....	3	..	..	3	..	{ 1 case 4 years 1 case 1½ years 1 case 2½ years
Total cases.....	120					

Many patients, however, though greatly handicapped, have been able to return to their work. Davis<sup>5</sup> has indicated that an

have not been published. Also, it is difficult to know whether improvement may last and whether or not in any particular

patient, the progress of the disease has been so slow that the operation has played no important rôle.

It is Davis' recommendation<sup>5</sup> that perhaps combined radiation therapy and myelotomy may prove to be the method of choice.

The various analyses made by Ley, Frazier, and others indicate that approximately 50 per cent or less of patients who have been treated by surgical intervention have been able to return to a useful occupation and remain employed for a substantial period of time. Frazier has felt that this improvement more than compensates for the possible failures and dangers of operation.

#### COMPARISON WITH X-RAY THERAPY

The treatment of syringomyelia for many years has been deep x-ray therapy, which in many cases has achieved an improvement of both motor and sensory disturbances. Delherm and Morel-Kahn<sup>6</sup> reviewed a large number of cases, with improvement in over 70 per cent. Their personal results were not quite so good and about one-third of the cases were aggravated by treatment. O'Brien,<sup>39</sup> in reporting thirty cases treated by irradiation only at the Boston City Hospital, found definite improvement in 75 per cent of the patients. The nature of improvement consisted in a cessation of pain, healing of trophic ulcers, return of thermal sensation, restoration of normal speech and deglutition, and in some instances ability to return to a gainful occupation. O'Brien believes that his later cases have shown more immediate improvement since the technique of Coutard has been employed, namely, protracted high tension, low intensity irradiation. Improvement occurred in so many cases and so promptly that he feels it is unreasonable to suspect that it was due to spontaneous remission or to the natural history of the disease. As Putnam has suggested: "It is natural to suppose that irradiation acts on the glial lining of the cavity or its blood vessels rather than upon its fluid contents. Indeed it would not be surprising if the

pressure within the cavity were actually increased by the breakdown of the cells in its walls. Thus operation and radiation should theoretically supplement each other." This seems to offer the best explanation for the results of combined therapy.

#### SUMMARY AND CONCLUSIONS

1. Three cases of syringomyelia are described in detail showing improvement over periods of one and one-half, two and one-half, and four years respectively, following surgical intervention. The interference employed was laminectomy and drainage of the syringomyelic cavity in one instance and generous decompression in two cases.

2. A review of the available cases from other clinics has been attempted. A conservative estimate of the ability of patients who have been able to return to a useful occupation would indicate that less than 50 per cent were sufficiently improved after operation to return to their vocations.

3. The indications for surgery must depend, in addition to the clinical picture, upon a careful study of the spinal fluid hydrodynamics with intervention limited to those cases revealing a partial or complete subarachnoid block.

4. The surgical technique practiced by the majority of surgeons who have treated these cases includes:

- A. The use of local anesthesia.
- B. An incision in the posterior surface of the spinal cord either in the midline or on the side of greatest clinical damage as so aptly described by Frazier.
- C. An attempt at permanent drainage by the use of drainage material, such as silver clips, muscle, dura, etc.
- D. Secondary operation in certain selected cases appears to be justified where the clinical condition is not improved or where there is a relapse following initial drainage.

E. Where the syringomyelic cavity is difficult to locate, laminectomy with decompression afforded by opening of the dura appears to be worthy of trial.

5. In agreement with Davis, Mixter and Putnam, it appears that the logical treatment of this disease is surgical intervention supplemented with irradiation, since x-ray probably exerts its influence solely on the gliosis while the cavitation may be adequately treated only by surgical drainage.

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# COMMON DUCT OBSTRUCTION

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**O**BSTRUCTION of the common duct is at all times a grave surgical condition, and although some of the causes, such as common duct stones, or pressure from without, are completely removable by surgery, most of them, unfortunately, including intrinsic obstruction involving the wall of the duct, stricture and malignancy, cannot be completely relieved. In addition to the mechanical difficulties presented by this problem, one is further handicapped by the unexplainable reactions of patients to this type of surgery. In late years we seem to some extent to be able to evaluate the dangers and the resistance of the patient, but our prognosis is by no means so accurate as in operations upon the pelvic organs. Such undetermined factors undoubtedly are concerned with physiologic chemistry, the sympathetic nervous system, and acute and chronic infections. A great deal remains to be learned before we will be able to approach biliary surgery with the same confidence as we do that of other intra-abdominal organs.

## ETIOLOGY

The causes of common duct obstruction are either congenital or acquired. While congenital defects are rather rare, some feel that icterus neonatorum, in a certain number of cases at least, is due to stricture, tumor or more frequently stone, in the common duct of the infant.

The acquired causes may be grouped under the following three subdivisions:

*A. Conditions Compressing the Duct from Without:*

1. Primary or secondary tumors of the head of the pancreas.
2. Enlarged glands from such conditions as malignancy, syphilis, tuberculosis, and Hodgkin's disease.

3. Aneurysm of the hepatic artery due to syphilis, tuberculosis, embolism, nearby suppuration, or injury.

4. Malignancy of neighboring organs.

5. Peritoneal adhesions.

*B. Conditions Affecting the Duct Wall:*

The only condition of importance here is stricture, which occasionally is of congenital origin, but is usually due to inflammation, ulceration and scar tissue formation, the result of stone in the duct or surgery of the duct. Prolonged T-tube drainage is a frequent cause of stricture.

*C. Conditions within the Duct Causing Obstruction:*

1. Parasites, such as roundworms.

2. Catarrhal or suppurative cholangitis.

3. Tumors, of which carcinoma, papilloma and adenoma are the outstanding examples.

4. Stone.

The most important cause of common duct obstruction is stone in the duct. While stones may form primarily in the ducts, they have usually originated in the gall-bladder and later have passed into the ducts; this latter condition obtains in about 20 per cent of gall-bladder stone cases. Infection caused by any bacteria, but particularly the *Streptococcus viridans*, and typhoid, and colon bacilli, reaches the biliary tree by way of the lymphatics, the bile, or the blood. It supplies the organic nucleus upon which, through stasis, precipitation of cholesterol and other salts, stone formation is completed.

A history of typhoid, pregnancy, or appendiceal disease is noted in many biliary stone patients, and occasionally there is a history or evidence of peptic ulcer or nose and throat affections. Sedentary habits, general atony, obstruction to drainage, interference with innervation, over-eating, and lack of exercise increase

the incidence of cholelithiasis. Fat women past the age of forty, who are of the blonde type, suffer more frequently than others (the famous Fair, Fat and Forty trilogy).

#### PATHOLOGY

The bodily damage from common duct obstruction depends upon the completeness and rapidity of the obstruction, as well as upon the presence or absence of preexisting inflammation and the etiologic factor. Courvoisier, nearly one hundred years ago, stated that in jaundice due to pressure on the common duct from without, the gall-bladder dilates, while with impacted stones in the duct, the gall-bladder is usually small. While this holds true in 90 per cent of cases, it is unreliable in about 10 per cent.

In any case of obstruction of the common duct the following pathology is present in greater or less degree:

*Hydrohepatosis.* There is a dilatation of the biliary tree above the obstruction, which extends even into the small liver ducts. It is greater as a rule in obstruction due to a cause other than stone: (1) because stone cases are usually accompanied by diseased and fibrosed ducts and gall-bladders which dilate less readily; and (2) because the cases of obstruction from pressure on the ducts usually do not have infection and fibrosis, are of shorter duration, and have more complete obstruction. The gall-bladder is contracted in 80 per cent of common duct stone cases.

*White Bile Formation.* When the pressure in the bile ducts increases enough, the bile stops forming and that in the biliary tree is absorbed. The mucous glands, however, continue to secrete, and thereby the so-called "white bile" is formed. This is greater in stone cases.

*Obstructive Jaundice.* Bilirubin, since it is formed from blood pigment by the reticuloendothelial system of the body and excreted by the polygnal cells of the liver, cannot enter the duodenum in obstruction of the common duct, and is therefore

absorbed. Thus jaundice is produced, which affects the entire body, particularly the convoluted tubules of the kidney.

Any loss of weight is dependent upon pain and loss of sleep, combined with infection and the commonly seen restriction of diet. Charcot's fever always means infection of the ducts—a cholangitis.

Three different types of stone may cause common duct obstruction:

1. *The Septic or Infected Type.* This is the type usually present. It is concentrically laminated, often faceted and multiple, and upon examination proves to be composed of cholesterol and calcium bilirubinate. Stones of this variety often occur in families.

2. *The Metabolic Type.* These are usually single, of a white color and radiate structure. They are made up principally of cholesterol.

3. *The Pigment Type.* This stone is seen in hemolytic jaundice. It is small, rice-like in size and presents a hard, black, brittle appearance. These stones are practically always multiple and contain no cholesterol.

#### SYMPTOMS AND SIGNS

Since there are so many causes of common duct obstruction, the symptoms and signs will naturally vary and depend upon the causative lesion, neighborhood affections, and whether or not infection or complications are present. Yet symptoms of the obstruction, per se, occur only when a foreign substance is in transit through the ducts, when infection has occurred, or when deficient drainage has resulted. Regardless of the cause, any common duct obstruction usually causes lowered resistance, with an itching, yellow, or bronze skin and yellow conjunctivae, and often transforms the patient into an irritable person who cannot sleep, who loses weight, and complains of a variety of gastrointestinal symptoms, such as gas on the stomach, belching, flatulence, fulness after eating, nausea, vomiting and distress after

eating certain foods, especially those of a greasy type. The pylorospasm and other gastrointestinal symptoms result from a reflex through the ninth dorsal segment, which supplies the stomach, pancreas and duodenum as well as the biliary tree.

The previous history in stone cases will often reveal the gastrointestinal group of symptoms to which jaundice and colic are added, but in other than stone cases the past history is often negative, or is only that of the causative lesion.

Pain or colic is usually of stone origin, but spasm of the ducts or the passage of clots, mucus, or fragments of a tumor may give similar, though usually milder pain. Colic is usually of a violent nature and is characterized by its sudden onset a few hours afterwards, variable duration and sudden cessation. The pain may be in the region of the gall-bladder, the epigastrium or the umbilicus, but may be, and frequently is referred to the back, the lower part of the right chest, or the shoulder. It may be of varying intensity, but usually is so severe that the patient is in agony and cannot be still. He rolls or tosses about, or even walks the floor in an effort to try to find a position which will give him some relief.

Jaundice is generally intense. It may be absent or slight in any case of common duct obstruction, but tends to be intense and progressive, without pain or infection in other than stone cases. Patients having stones in the duct have incomplete, milder jaundice, with periodicity in intensity, which may appear twenty-four to forty-eight hours after an attack of colic. Mild jaundice may rarely follow colic from stone that does not leave the gall-bladder.

Fever is not apt to be present unless there is some infection. When Charcot's fever occurs, characterized by chills, sweats, and irregular, intermittent, steeple type temperature curve, one can be sure that a cholangitis has supervened, and especially if the attacks are of short duration and occur with or after the pain and jaundice. Infected bile can cause cholangitis and if

the infection extends into the hepatic ducts a continuous fever may follow.

The liver enlarges in most cases of obstruction and, with the enlarged gall-bladder is sometimes palpable.

#### DIAGNOSIS

The common duct obstruction per se is easily diagnosed when the jaundice is shown by blood, urine, and stool examinations to be of the obstructive type, but the causative lesion may be diagnosed only with difficulty or may be entirely missed. The blood shows an increased icterus index, a positive and usually direct immediate Van den Bergh test, with red blood cell changes of decreased fragility, macrocytosis and an absence of reticulocytes. The serum phosphatase is often increased above normal, the bromsulfalein test is normal unless the liver is damaged, and bile salts are retained in the blood. The stools are clay colored and contain very little or no stercobilin, and on duodenal drainage, bile is absent or scant.

If the liver is not damaged, the urine shows a normal amount of sugar after the galactose test. The urine is dark and contains bile, but shows little or no urobilinogen; if there is complete absence of urobilinogen in a case of jaundice, common duct obstruction is indicated.

Of especial importance is the fact that this type of jaundice is accompanied by itching.

#### *Conditions Compressing the Duct from Without:*

1. Carcinoma of the head of the pancreas. There is a jaundice which is persistent and progressive; it usually is intense and of a mahogany hue. It is not accompanied by fever or pain, but there is a palpably enlarged gall-bladder.

2. Adjacent tumors and glands. These are diagnosed only by the signs and symptoms of each condition.

3. Aneurysm. While this is usually missed; it should be thought of in syphilis, endocarditis and injury as well as in tuberculosis and suppuration.

*Conditions Affecting the Duct Wall:*

1. Congenital affections show persistent jaundice and the infant soon dies. Autopsy reveals the pathology.

2. Scarring, ulceration and stricture of the duct give a history of the presence or passage of a gallstone, or of surgery done on the duct with or without prolonged T-tube drainage.

*Conditions within the Duct:*

1. Inspissated bile has no distinguishing signs.

2. Parasites. A careful history and stool examination will show parasites in the gastrointestinal tract and the further diagnosis of them, being in the biliary ducts, can only be conjecture. I have removed dead ascarus worms from an abscess about the ducts. Hydatid cysts may cause pressure on the ducts or may cause cholangitis if the contents drain into the ducts.

3. Tumors. Time or surgery is necessary to distinguish most cases of papilloma or cystadenoma from carcinoma of the ducts since all show obstruction which becomes more or less complete, and produces a jaundice which is intense, persistent and progressive, and without pain or fever.

4. Stone. If the stone is in transit, colic is severe and ceases only when the stone is passed or when it becomes "quiet." Jaundice follows within twenty-four to forty-eight hours and tends to clear up more or less between attacks, but fever is absent unless infection occurs, in which case attacks of Charcot's fever tell of cholangitis. The gall-bladder is not palpable as a rule since it is small, but the x-ray may show stones in it or even in the ducts. Duodenal drainage is very likely to reveal cholesterol and calcium bilirubinate crystals.

## DIFFERENTIAL DIAGNOSIS

1. *Catarrhal jaundice* is generally a disease of the young, lasting two to six weeks, and has no pain but only mild gastrointestinal symptoms. A positive ga-

lactose test may be given showing liver damage, and the Van den Bergh test is often indirect but is not to be definitely relied upon.

2. *Hemolytic jaundice* shows anemia with a jaundice of less intensity which is unaccompanied by itching. There are often pigment gallstones in the gall-bladder. Bile salts are not retained in the blood, the icterus index is lower than in obstruction of the duct, and the red blood cells show increased fragility, microcytosis and an increase of reticulocytes. The urine contains an increase of urobilinogen, but no bile, and the stools are normal.

3. *Hepatic Cirrhosis*. A milder icterus combined with ascites, hemorrhages and a low bromsulfalein test point to liver disease.

4. *Malaria* is diagnosed, and distinguished from Charcot's fever, by the leucopenia, and the enlarged spleen in conjunction with periodicity and parasites in the blood.

5. *Sepsis*. The history and other clinical signs in conjunction with a mild jaundice and remittent fever and blood cultures distinguish this condition.

6. *Syphilitic capsulitis* may give difficulty unless a Kahn is run.

7. *Acute Yellow Atrophy*. The history, residence, and hemorrhages, with the black vomit, are distinctive when combined with a small liver functioning poorly. Urea and uric acid are decreased both in the blood and the urine, and leucin and tyrosin are excreted.

8. *Chronic Pancreatitis*. It must be remembered that pancreatitis may follow biliary stone and that the two are hard to differentiate clinically. In the former, the gall-bladder is often enlarged, and there is an impaired digestion of fats and proteins which gives rise to pale, abundant stools covered with a scum of fat and containing unstriated muscle fibers and unsaponified neutral fat. Glycosuria is often present.

9. Urinary and gastric affections as well as tabes may need to be excluded if jaundice is present.

10. Liver affections, such as abscess, cancer, and hydatid cyst, as well as poisons, need exclusion.

### PROGNOSIS

The prognosis depends on the cause and accessibility of the lesion, as well as the condition of the entire body, especially the liver and pancreas.

Carcinoma of the pancreas, malignancy of the abdominal viscera with metastasis, Hodgkin's disease and tuberculous glands, are hopeless, as are cases of leukemia, pyelephlebitis, and cholangitic abscess.

Syphilis may be cured and chronic pancreatitis is often helped by biliary surgery, but aneurysm and congenital defects are serious. Benign tumors of the ducts should have a better outlook although the operative procedure itself carries a high mortality. Even carcinoma should have a lower mortality since metastasis is relatively late.

Patients with stones in the ducts have a very favorable prognosis if properly handled; the stones of hemolytic jaundice usually disappear after splenectomy and require no biliary surgery. The pancreas is frequently affected by stones in the ampulla of Vater below the duct of Wirsung.

### TREATMENT

The treatment is essentially surgical.

*Preoperative Management.* Pain must always be relieved, and this is done by morphine and atropine in doses large enough to be effective, combined at times with hot enemas, heat applied locally to the abdomen, and even whiffs of ether or chloroform in selected cases. Preoperative measures are vitally necessary and a positive galactose test makes them still more imperative, but if the serum bilirubin does not decrease in a week further delay is not advisable.

The diet requires a reduction in fat and a decided increase in carbohydrates. Orange juice with sugar should be given every few

hours for three or four days before operation. Fluids in amounts of 3 to 5 liters daily are necessary. Where vomiting is present, fluids must be given parenterally, preferably by vein or by hypodermoclysis. Where vomiting is excessive, the Wangensteen apparatus is also valuable. Five per cent glucose in normal saline by vein is of especial value. In all cases it is wise to give 50 Gm. of glucose by vein the evening before operation. One or two blood transfusions and 5 c.c. of a 10 per cent solution of calcium chloride daily for three days, in conjunction with parathormone, are very valuable in reducing the danger of hemorrhage.

The medication consists of sodium alurate, gr. 3, the night before and again one hour before the operation, followed by scopolamine, gr.  $\frac{1}{200}$ , one-half hour before, and morphine, gr.  $\frac{1}{4}$ , combined with atropine, grain  $\frac{1}{150}$ , fifteen minutes before the operation.

*Operation.* The anesthetic of choice is 200 mg. of novocaine crystals dissolved in 2 to 2.5 c.c. of spinal fluid and injected intraspinaly. This is followed preferably by the Bevan incision to open the abdomen. From there on the procedure depends on what is found:

#### A. Pressure on the Duct from Without.

(a) Carcinoma of the head of the pancreas. Only palliative measures can be used, such as cholecystostomy or anastomosing the gall-bladder to the stomach, duodenum or jejunum.

(b) Chronic Pancreatitis. If gallstones are present they require proper treatment, but if not, then cholecystostomy or cholecystenterostomy may be used. The best procedure is probably cholecystectomy and drainage of the common duct.

(c) Aneurysm. There is no treatment of this condition itself, but cholecystenterostomy may be done since the abdomen is open.

(d) Glands about the Duct. Some cases warrant an attempt at removal, but in hopeless cases cholecystenterostomy may be done for palliation.

(e) Tumors of other organs are usually not amenable to other than cholecystenterostomy.

*B. Conditions in the Wall of the Duct.* If stricture should follow passage of a stone, and the gall-bladder is movable and no other stone present, cholecystenterostomy is feasible. A ligated duct demands release. If the stricture follows surgery, adhesions may be dense and the duct not found, in which case anastomosis of the gall-bladder to the stomach, duodenum, or jejunum may be done, or drainage may be used for a time and then the tract anastomosed to the duodenum over a tube fixed by a silk suture. If a stricture is localized, accessible, and annular, it may be cut at right angles and a T-tube inserted for a short time; other cases may have an implantation of the duct above the stricture into the duodenum. Some have tried excision of a localized stricture and then performed an end-to-end anastomosis.

*C. Conditions within the Lumen of the Duct.* (a) Parasites can be removed surgically and medication given afterward.

(b) Inspissated bile requires drainage of the duct.

(c) Cholangitis requires removal of the cause, such as stones, and drainage of the ducts and gall-bladder.

(d) Stones. If the stone is accessible above the duodenum, the duct should be opened and the stone removed, after which drainage both of the gall-bladder and the common duct is indicated. A cholecystectomy should not be done at this time. When the stones are lower down they may be milked back up above the duodenum in some cases and removed, but if this is not possible then retroduodenal or preferably transduodenal removal is needed—again draining the duct and gall-bladder. When adhesions are dense it may be necessary to locate the duct by passing a probe up through the duodenal papilla.

(e) Tumors of the Ducts. Excision of early malignant and most benign tumors is indicated. If the growth is supraduodenal and below the cystic duct, a preliminary

gall-bladder drainage or cholecystenterostomy is wise, the excision being done at a second operation. Lesions of the ampulla or duodenal part of the duct call for a transduodenal excision if possible, after drainage as above. After excision, some have tried an end-to-end anastomosis, or implantation of the duct into the stomach or duodenum.

*Postoperative Treatment.* Morphine should be given to allay pain and restlessness, but excessive amounts should be avoided because it tends to increase distention. If gaseous distention occurs, it can be handled by gas enema, heat to the abdomen and pitressin if needed. I am a firm believer in keeping peristalsis active because if the peristalsis and bowel movements are maintained, the patient will not die from the distention, even though infection be present. In this connection, it is a good principle to insert the Wangenstein apparatus immediately after operation, as it helps care for and prevent nausea, vomiting and gas. Bile is collected, measured, and should there be dehydration and loss of weight, it can be re-fed to the patient in grapejuice, through a tube or by rectum.

Blood transfusions after operation are valuable, and fluids by vein and hypodermoclysis are needed for a few days in quantities of 3 to 6 liters. Glucose 5 per cent in saline should be given by vein in liter amounts twice or three times daily and the balance of fluid as normal saline given by hypodermoclysis.

The bladder should be watched and catheterization done if necessary, the output of urine should be measured, and the urine examined daily. If stimulation is needed, digitalis is the drug of choice. Feeding by mouth is begun when the patient's condition admits, starting with fluids and slowly increasing up to normal diet by the end of ten days. The drainage tube in the common duct may be clamped at stated intervals, after about ten days, and if bile passes normally through the duct and no symptoms are caused thereby, the tube can be removed.

## CASE REPORTS

## CASE I. Carcinoma of ampulla of Vater.

An Italian male, age 52, gave a history of an indefinite gastric upset in October 1933, after which he was well until December, when he developed a painless jaundice together with fever, vomiting and malaise. He noted that his stools were light and his urine dark. He grew gradually worse and in January 1934, he was admitted to the hospital and placed on biliary drainage and a fat-free diet with little result. His G.I. series was negative and the Van den Bergh test ranged from 2.2 to 18 during his stay in the hospital. March 1, he left the hospital against advice, and returned March 6, decidedly worse. He had also developed a diarrhea and an enlarged gall-bladder. Laparotomy revealed a large gall-bladder with no stones, but palpation of the ampulla region showed a small nodule. The gall-bladder and common duct were both drained. The tube was removed in a week or so and the wound healed.

During May and June, the jaundice nearly cleared and the Van den Bergh dropped to .25. On July 5, however, he developed chills, sweating and fever, followed by intense jaundice, which never disappeared. In July and August, he had four or five attacks which continued at intervals of a few days in September and October. At his last admission on October 12, he complained of the painless jaundice with the Charcot fever, syndrome, itching, and loss of 20 pounds of weight. He was very nervous, slept poorly and felt weak.

On examination he was thin and markedly jaundiced, with evidence of scratch marks on his body. The scar of the recent laparotomy was visible. His liver and gall-bladder were enlarged and his mouth was very dirty.

The Kahn test was negative, the Van den Bergh 15, and the icterus index 95. The urine was dark but contained no urobilinogen.

As conservative treatment gave no benefit, laparotomy was done. The presence of metastasis to the liver caused us to do a cholecystojejunostomy. The Wangenstein was started and glucose and saline were given by vein; blood transfusions were administered, but the Charcot attacks continued, the anastomosis broke down, and the patient died.

Autopsy showed the broken down anastomosis and revealed carcinoma of the ampulla of Vater with metastasis to the liver, together with cholangitic abscesses. A fistula was found

between the common duct and the stomach which may have explained the jaundice clearing up in June. Microscopy of the tumor showed it to be adenocarcinoma.

## CASE II. Stricture of the common duct.

A white female, age 33, was admitted September 6, 1934. She gave a history of having had six attacks of pain in the right upper quadrant and back with vomiting and flatulence since November 1933. Greasy foods had distressed her during this time. She had noted no jaundice or alteration of her stools or urine at any time, but had lost 18 pounds in weight.

She gave no history of typhoid. She had had three children and four miscarriages; a pelvic laparotomy with appendectomy had been performed.

On examination, she appeared thin, but had no jaundice. The gall-bladder area was quite tender. A few piles were present. Otherwise examination was negative.

On September 8, a cholecystectomy was done; many adhesions were found, but the common duct appeared normal. On September 17, pain developed in the right upper quadrant, followed by jaundice, distention of the abdomen with fluid, swelling of the legs and flatulence. The icterus index was 52 and the stools were free of bile. The abdomen was tapped on October 6, when 8000 c.c. of bile-stained fluid was removed, and again on October 10, when 4000 c.c. was removed. Bile was present in the urine, the Van den Bergh was 2.5 and the x-ray showed the diaphragm high.

At operation on October 23, no peritonitis was present and the common duct could not be located. No stones were found, and drainage was therefore instituted. In two weeks the bile was tested for sterility and re-fed to the patient in grapejuice. The drainage stopped and the wound healed. It is possible that a fistula may have occurred which allowed the bile to enter the gut.

At a later date a probing of the duct via the duodenal papilla may be necessary, or a drainage tract can be anastomosed to the duodenum over a tube.

## CASE III. Pylephlebitis with common duct stone.

A 46 year old mulatto was admitted to the medical service October 4, 1934, giving a history of pain in the right upper quadrant, vomiting and jaundice of ten days' duration. In the last two days the pain had been continuous. She had had typhoid as a child and had

borne ten children, all now dead. She stated that she had been afflicted with frequent colds all her life.

Emaciation was extreme, jaundice was intense and she was markedly atherosclerotic. She had poor sight, her teeth were all missing, a thyroid adenoma was present and the liver and gall-bladder were enlarged and tender.

Laboratory examinations showed a 4 plus Kahn, basal metabolic rate of plus 4, and a Van den Bergh of 4.38; the feces contained no bile, the urine was positive for urobilinogen in 1-10 as well as full of bile, and the x-ray showed no shadow after the Graham dye test.

After admission the patient developed Charcot's fever and the pain and jaundice became worse. She improved somewhat and then became worse again, so that, on October 24, she was transferred to the surgery service, where she was given intensive preoperative care and operated upon. Stones were found in the gall-bladder and the ampulla of Vater which were removed, and the gall-bladder and common duct were drained. Blood transfusions, fluid by vein and skin were given and she was relieved of the chills but died a few days later. Autopsy revealed pyelephlebitis with cholangitic abscesses.

#### CASE IV. Carcinoma of the pancreas.

An Indian male, age 33, about one month before admission, on November 24, 1934, noted jaundice and hoarseness, and a lump in the left side of his neck. About the same time the stools became light and the urine dark. During the last four months a loss of 33 pounds had occurred. He gave no history of tuberculosis or lues but he had always been a hard drinker. Fifteen years before he had had malaria, rheumatism and appendicitis.

He came to the hospital because of colic although the above findings were also present and he also had a small left pupil and a large gall-bladder and liver. The Van den Bergh was 20, but other tests, including an x-ray of chest, were normal.

Laparotomy, December 1st, showed a distended gall-bladder and carcinoma of pancreas, for which cholecystostomy was done, but he died later.

#### CASE V. Stricture following removal of common duct stone.

A white female, age 34, had a cholecystectomy in April 1933 for stones, a few days after which she developed colic and jaundice and continued to have attacks up to admission on

September 18, 1934. No fever or chills had ever occurred, but she had lost 17 pounds in weight.

The only laboratory findings of value except those of jaundice were a blood cholesterol of 495 and the obtaining of bile by duodenal drainage.

On October 4, a small stone was removed from the common duct and a T-tube inserted, but drainage and jaundice persisted. Lipiodol was injected through the T-tube, revealing obstruction of the duct. Operation was again done, but adhesions were so dense that the drainage tract was anastomosed to the duodenum over a catheter held in place by a silk suture. Complete recovery followed.

#### CASE VI. Stone in the common duct.

A white female, who for twelve years had suffered from attacks of colic, was admitted September 18, 1934 with fever, jaundice and pain, but without chills.

Except for obstructive jaundice, the laboratory tests were negative and since the fever continued, and her condition was poor, a rapid cholecystostomy was done September 22. Many adhesions were noted and the gall-bladder was very thick. The next day, the patient developed dulness at the right lung base and for two weeks ran a fever, during which time drainage was poor. On October 19 and again on October 25, she had a chill, followed by an increased jaundice. Lipiodol was injected into the tube and showed duct obstruction. Operation was again done and a stone was removed from the common duct. Drainage, both of the duct by a T-tube and of the gall-bladder by a catheter, was instituted. Complete recovery followed.

#### CASE VII. Diffuse carcinoma of the common duct.

A diabetic white female, age 57, was admitted October 16, 1934, with pain in the right upper quadrant and back of two weeks' duration. She complained of belching and fulness after eating of two months' duration. No fever, chills or sweats had occurred, but there had been loss of definite weight.

On examination she was obese; her teeth were missing; she had no jaundice; and x-ray studies revealed gallstones, but otherwise a normal gastrointestinal tract. All laboratory tests were normal.

Cholecystectomy was done November 2, after which auricular fibrillation occurred, which was treated by digitalis and carotid sinus pressure. The woman recovered and went home, but in December returned with all the



above symptoms, plus jaundice. Operation was again done after four days' preparation. Many dense adhesions were found. The common duct, which was hard, firm and rigid, like a tube, looked as if a diffuse primary carcinoma had developed in it. The duct was incised and a ureteral catheter, the largest tube that could be inserted, was passed. Digitalis and insulin were used postoperatively in conjunction with transfusion of blood and fluid by vein, and the Wangenstein apparatus was used. Bile drained through the wound, but the patient died. Autopsy was refused.

#### SUMMARY

1. No one symptom of obstruction is diagnostic. Since two conditions may be present, local pathology may show and general affections may be missed.

2. A marked jaundice with clay-colored stools is usually significant of common duct obstruction, most likely due to cancer of the pancreas or bile ducts, chronic pancreatitis, gallstones or catarrhal jaundice. Transient jaundice, in the young, is usually catarrhal.

3. A large liver, with jaundice, most often shows common duct obstruction, lues, cancer, abscess, cirrhosis or poisoning.

4. Any jaundice should be relieved by palliative means as much as possible before surgery is done, inasmuch as the more nearly complete the obstruction is, the more the danger of cholemia. Early thorough treatment spares the liver, pancreas and kidneys. A slow pulse, in jaundice, is usually not present unless chronic pancreatitis occurs. If, with the jaundice, findings point to an essentially complete obstruction, the likely causes are tumors of the ducts or pancreas, stricture, or an accidentally ligated duct.

5. Fever may be present with the attacks due to an infected gall-bladder, but when the hepatic ducts are infected, a continuous fever may result. Charcot's fever means cholangitis as a rule, although jaundice, fever and rigors can follow pylephlebitis and hepatic abscess; malaria and sepsis might give a similar picture.

6. Biliary stones are often found post mortem. Icterus neonatorum has been caused by stones. Females who have been pregnant or had typhoid often have stones form in the gall-bladder and twenty percent of them have common duct stone also, which usually gives a small gall-bladder with colic and jaundice. There may be no pain or jaundice, however, and the gall-bladder may be enlarged, especially if the cystic duct is blocked.

Stones may accompany tumor or stricture. If jaundice follows right upper quadrant pain, it most likely is due to common duct stone. Recurring jaundice in a middle aged woman, with or without colic, is almost pathognomonic of the same; chronic pancreatitis alone may confuse. Should pain occur without jaundice after cholecystectomy, it calls for duodenal drainage and examination of the bile for crystals of cholesterol and calcium bilirubinate.

7. Tumors of the pancreas and biliary ducts usually give a painless jaundice with an enlarged gall-bladder, although pain, Charcot's fever, or a small gall-bladder may be present. Early diagnosis and treatment are imperative, because benign lesions may become malignant, and all malignant growths of the duct metastasize slowly. Carcinoma is more frequent in males, while stones form more frequently in females. Recurrences of jaundice for years is against malignancy, but on the other hand, a middle-aged person with loss of weight, having a history of short duration, together with a deep persistent jaundice without colic, and an enlarged gall-bladder, is almost surely suffering from carcinoma of the pancreas or the bile ducts.

8. Pylephlebitis and cholangitic abscesses cause death, and diabetes is a very serious complication. Vocal cord paralysis may be dependent upon Ewald's node which might be the first sign of abdominal malignancy.

9. Spinal anesthesia spares the liver, while ether, chloroform and avertin may further injure it. A fall in blood pressure is

met by the Trendelenburg position combined, if necessary, with adrenalin or ephedrine by hypodermic, 50 c.c. of 50 per cent glucose by vein, a few whiffs of ether combined with artificial respiration, and even massage of the heart and adrenals through the abdominal wound.

10. In the operative work the gall-bladder should always be left in until it is made sure that the duct is all right. The duct should be explored in all suspicious cases, after needling it to be sure the portal vein is not entered; a stone may not be palpable if the duct is thick. It should be opened if there is or has been jaundice, and probed with a uterine sound. Suction, should be used if necessary. Then the duct should be wiped out with gauze, and drainage inserted.

Fistula of the duct into the gut calls for operation in most cases.

The duodenum should be opened, if necessary, and if a condition is found which prohibits further surgery, the gall-bladder can be anastomosed to the duodenal wound. A stone in the ampulla may require transduodenal removal, if it cannot be removed through the duct above the duodenum. Tumors of the ampulla may be removed transduodenally and the duct reimplanted into the duodenum.

11. Postoperative hemorrhage may be lessened by the use of blood transfusions before operation in conjunction with parathormone hypodermically, calcium chloride by vein, and duodenal drainage. Bile pigment is said to fix the calcium of the blood. Purpuric spots and increased sedimentation rates are indications for blood transfusions before operation.

Prostigmin has recently been added to the armamentarium for the care of postoperative distention.

Atelectasis after operation is more frequent following biliary surgery than any other type except gastric, and its incidence can be reduced by rebreathing of carbon dioxide and oxygen, deep breathing exercises, and frequent changing of position. Slapping the back sharply will often

help loosen a plug of mucus from the bronchus.

After release of obstruction, the bile for a few days shows absence of bile salts, increased calcium, and decreased sodium chloride content. If dehydration and loss of weight occur from loss of bile, the latter can be re-fed to the patient in grapejuice or given by rectum.

Lipiodal through the drainage tube may be used to reveal the state of patency of the ducts, in cases not progressing normally.

This paper was prepared at the direction of Walter Estell Lee, M.D., Vice-Dean of Surgery, of the Graduate School of Medicine of the University of Pennsylvania. It is being published with his permission, for which I wish to express my deepest appreciation.

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# HIGH LIGATION OF CYSTIC VESSELS IN SUBSEROUS CHOLECYSTECTOMY\*

## THE USE OF SILVER CLIPS

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SUBSEROUS dissection<sup>1</sup> is the safest and best for cholecystectomy. This is true for the chronic stone-bearing gall-bladder, and has been emphasized recently by MacGuire<sup>2</sup> for the acutely inflamed vesicle. In removal of a cyst from the tissues, the surgeon works as close to its wall as possible, the only method which insures against damage to surrounding structures. The same principle holds for cholecystectomy, since dissection close to the wall of the gall-bladder prevents damage to the liver, hepatic artery or bile ducts, and with proper methods, avoids hemorrhage from the cystic artery. In subserous cholecystectomy, particularly from above downward, the surgeon is always on safe ground. By the time the dissection has reached the cystic duct the main hazards are pushed aside and the only structure left to be concerned with is the common duct. This can be exposed cleanly and safely at its junction with the cystic duct. The junction, a favorite lodging place for stones, can be palpated; or the cystic duct can be opened and in many cases the common duct probed through it; or the stump can be used for drainage, according to Sweek.<sup>3</sup>

Subserous dissection from above is possible in about one-half the cases; in the other half the serosa is too adherent. With this method a smaller incision can be employed and through it a better exposure obtained than by a larger incision when using the method of removal from below upward. After preliminary exploration of the region, the other viscera can be walled off and self-retaining retractors placed. The packing does not have to be shifted continually as

is the case with dissecting cystic artery and duct in a deep hole under difficulties of vision and approach. In addition to easier and safer surgical procedure, the patient has the advantage of easier and quicker recovery—out of bed in seven days.

Dr. William Mayo has said that every additional inch added to the abdominal incision increases the patient's stay in the hospital by several days. With a smaller incision the patient can breathe better and move better. If a large incision is made, the liver dislocated, and trauma to other viscera increased, there is more danger of pulmonary or subdiaphragmatic complications, post-operative distention, and later, adhesions and herniation.

Let it not be assumed that I am advocating a small abdominal incision regardless of circumstances. A surgeon must be able to see well and work easily, surely, and safely. With subserous cholecystectomy and the modification to be described, this is as readily accomplished through an incision of 4 to 6 inches as with one 8 to 10 inches long.

The difficulty in removal of the gall-bladder from above downward has been in control of hemorrhage. This is not dangerous, as it would be from a free flowing cystic artery in the depths of the abdomen when below-upward dissection is used, but it is a troublesome oozing from small branches, interfering with vision in dissection. Control of this hemorrhage, particularly in subserous cholecystectomy, can be easily attained by taking advantage of one anatomic point: *the cystic arteries run on, not in, the wall of the gall-bladder*. In other words they are subserous. By the use of

\* From the surgical clinic of the Portsmouth Hospital, Portsmouth, N. H.

proper instruments they can be dissected up readily, with their strands of supporting fibrous tissue, and ligated.<sup>4</sup>

jawed Collins clamp and is pulled up. If the serosa is glistening and the gall-bladder is not shrunken and fibrotic, subserous

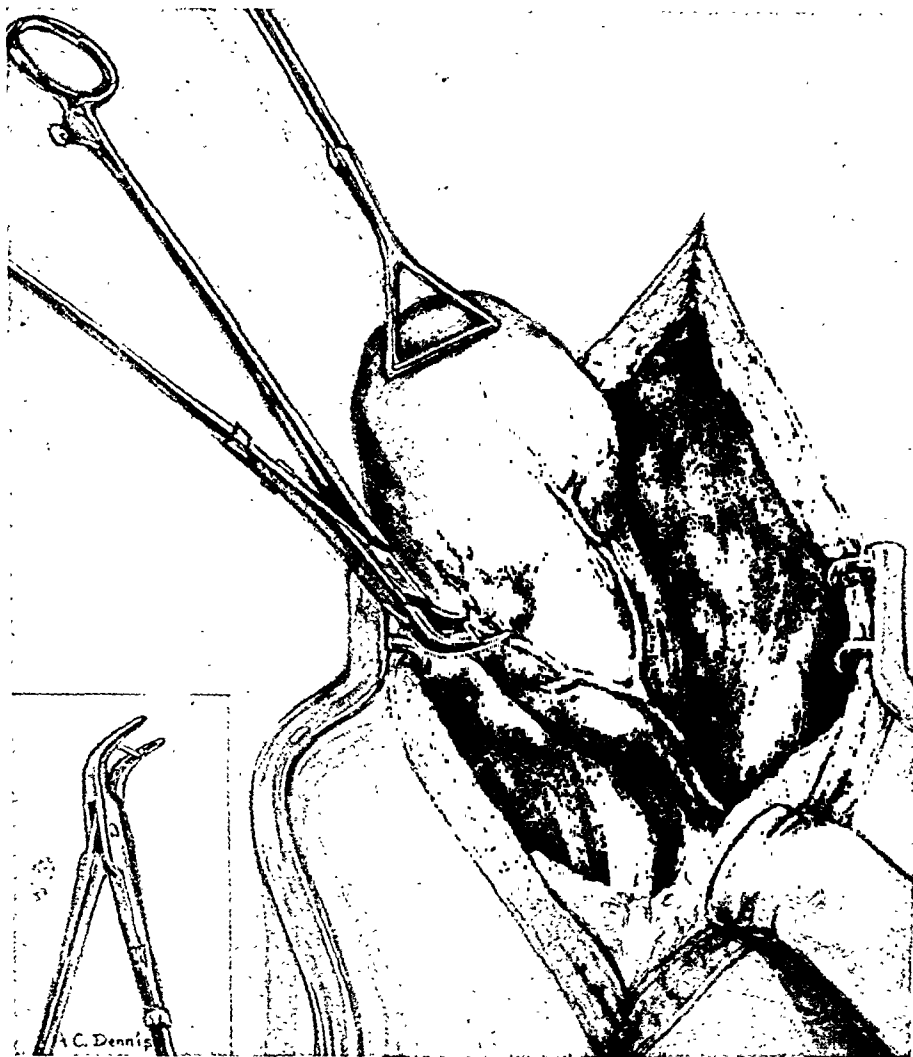


FIG. 1. Dissection of cystic vessels off the wall of the gall-bladder through slits in the serosa, and application of silver clips. One arm of the clip rests flatly in a groove on the dissecting jaw of the clamp. Insert shows the flange on the other arm of the clip which slides along the groove in the other jaw of the clamp and clasps the tissue firmly as the clip is closed.

The *technique* of a method for subserous cholecystectomy, utilizing the fact that the cystic artery branches under the serosa, will be described, and the use of modified Cushing silver clips for hemostasis will be illustrated.<sup>5</sup>

After the stomach, duodenum and colon have been packed away and self-retaining retractors placed, the fundus of the gall-bladder is grasped by a soft, triangular-

dissection can generally be done. In the case of acute inflammation, if the vesicle is distended and not gangrenous nor densely adherent to other viscera, the serosa will often strip. In any case this can be tested through an incision at the fundus near the liver edge.

A word should be said here with regard to surgical treatment of acute cholecystitis. If the inflammation is pronounced or ad-

*vanced the vesicle should be drained, not removed by any method.* In some mild cases subserous dissection will work well; in a

fective wall as possible. The author has devised an electrosurgical method whereby a virtual cholecystectomy can be

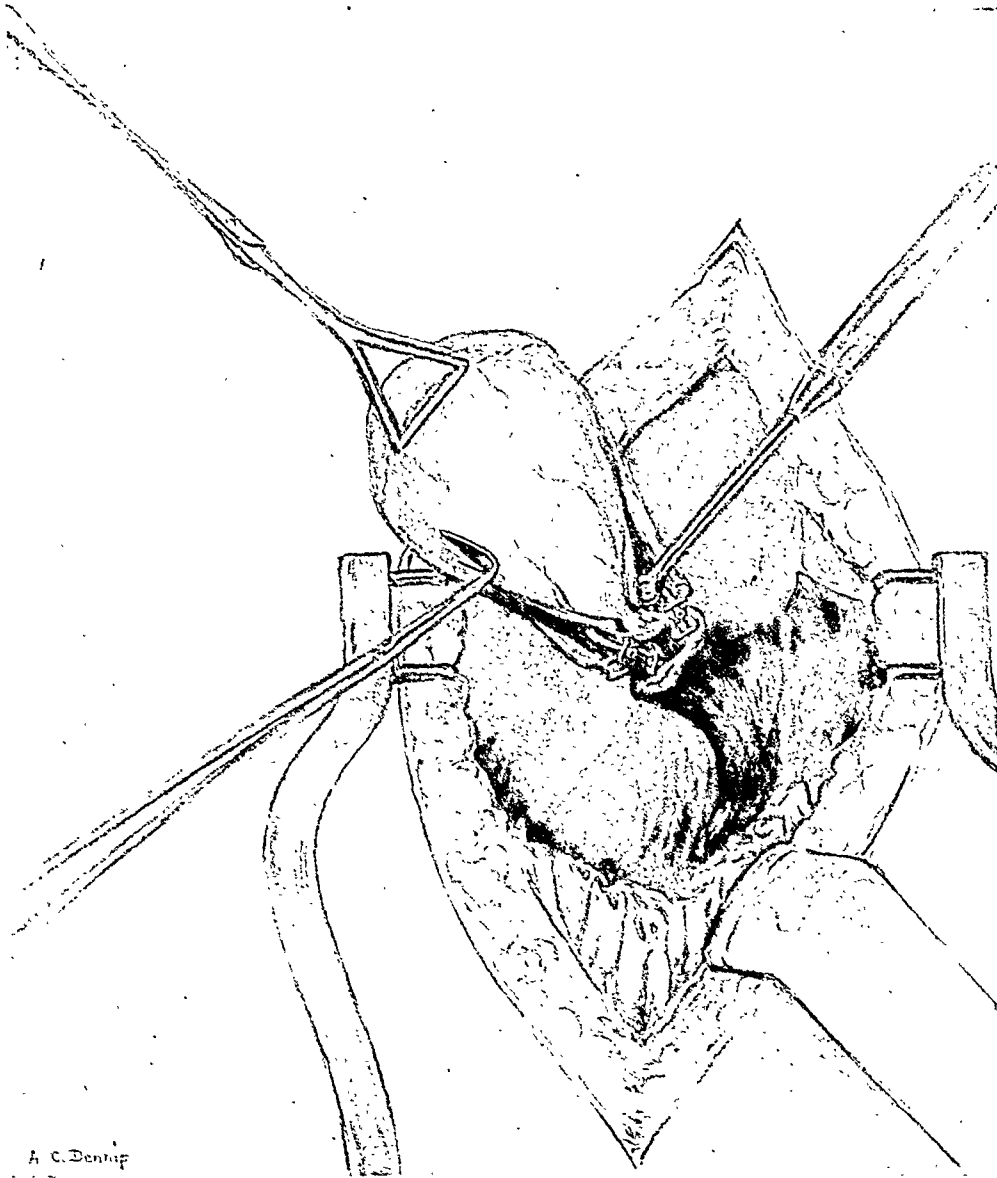


FIG. 2. Clips holding cut cystic vessels. On the left are shown right angled scissors dissecting and cutting serosa; on the right is the Walker suction dissector in action.

few others where this cannot be done, particularly if a moderate acute reaction is superimposed on chronic fibrosis, electro-cholecystectomy,<sup>6,7</sup> through control of hemorrhage, is simple and safe, and does away with the necessity for a second operation. But in advanced acute cholecystitis with involvement of adjacent structures, the safest method is drainage with as little breaking down of the pro-

performed through fulguration of the mucosa—electro-cholecystocausis.<sup>8</sup>

If the serosa can be dissected, the first step in the method under discussion is to secure the branches of the cystic artery: With a sharp knife, short incisions are made through the serosa along two to four main branches of the cystic artery on the lower third of the gall-bladder at points readily accessible. Then each vessel, with

its supporting strand of tissue, is dissected up with one jaw of the clamp carrying the silver clip. (Fig. 1.) The slip is applied by this purpose; they have short jaws and rounded tips, the sharp points at the ends of the cutting surfaces having been ground

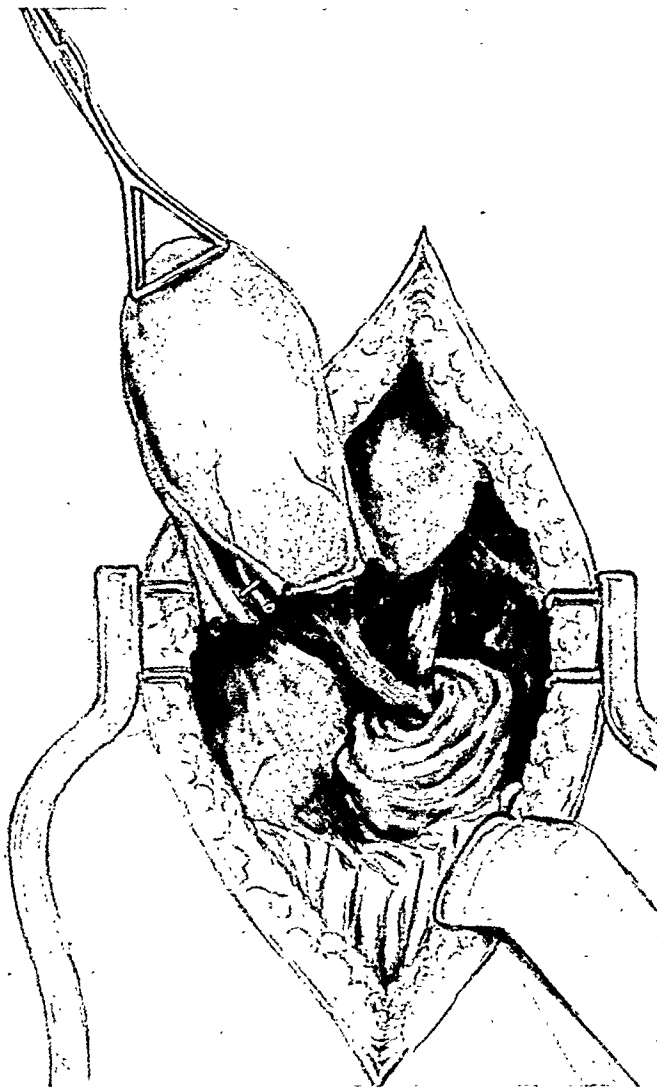


FIG. 3. Peritoneal cuff (somewhat diagrammatic) dissected to junction of hepatic and cystic ducts. The clipped stumps of the cystic vessels have been carried down with the cuff and are a safe distance away. The gall-bladder has been dissected from the liver bed and is free to the ducts, which can be easily explored.

closing the jaws of the clamp tightly. The stiff wire of the clip with the flange on one end (Fig. 1, Insert) holds it securely. Then with right-angled scissors the vessels and serosa are cut across the front of the gall-bladder above the clips. The serosa is slit up along the sides and over the top about 1 or 2 cm. from the liver. (Fig. 2.) The right-angled scissors are specially made for

off so that they will not tear the serosa. Usually one tip can be inserted under the serosa and with the jaws fixed and slid along, the serosa can be dissected up and cut around the liver margins. There will not be much bleeding. If a spurter is encountered it can be stopped with a silver clip.

After the serosa is cut around the margins, dissection proceeds from above

close to the gall-bladder. Clifford Walker's suction tonsil-dissector is a great help. (Fig. 2.) In the gall-bladder bed there is a definite, rather firm layer of fibro-areolar tissue which should be left on the liver. With scissors it can be cut close to the gall-bladder without hemorrhage. The dissection is carried down on all sides, separating the cuff of serosa with the stumps of the clipped vessels on the front. (Fig. 3.) If definite firm strands of tissue are encountered anywhere it is best to clip them since they may carry branches of the artery.

When the cystic duct is reached, all dangerous vessels are to the side. Strands of tissue near the duct are cut with impunity, and the cystic is cleared to the common duct. The few small vessels near the common duct are brushed away without much bleeding.

The junction of the cystic and common ducts should be thoroughly palpated. It is a favorite lodging place for stones. Even a small one left here will cause a recurrence of biliary colic and necessitate a second operation.

If there is a reasonable suspicion of stone in the common duct, such as a history of recent jaundice, or marked vomiting associated with biliary colic,<sup>9</sup> and if dilatation of the duct is present, it should be explored. A little bile can be allowed to well out of the stump of cystic duct; if clear there is probably no débris in the passages. If bile will not come through the cystic duct the common duct can be aspirated with a fine hypodermic needle. Should exploration of the common duct be decided upon, the safest method is to do it through the stump of the cystic duct. If this is too narrow it can be split down the front into the common duct. After probing (and dilatation of the sphincter of the common duct) this slit can be sewed up over a catheter in the cystic duct with little damage to the common duct. Sometimes it is more feasible to incise the common duct below the stump of the cystic.

If there is no indication for exploration of the common duct, the cystic duct is milked

upward, cut off about 1 cm. from the common duct, and the stump left loose. If a drop of clear bile can be expressed, proving it free of stone, the stump is doubly tied with O chromic catgut.

With the cystic duct thus secured, and in the absence of bleeding from vessels or oozing from the liver bed (which should have been left covered with areolar tissue) or damage to the liver elsewhere, the wound is not drained. If feasible, the peritoneal tissue cuff (Fig. 3) is pulled up over the stump of the cystic duct, and this and the cut edges of serosa whipped together over the gall-bladder bed.

Omission of drainage applies only to those cases where acute inflammation is absent and where the perfect conditions mentioned prevail. With the acutely inflamed gall-bladder, whether removed subserously or by electrosurgery, the wound should be drained.

#### SUMMARY

The advantages of subserous cholecystectomy are: (1) facility of operation through a small incision; (2) greater safety, particularly in the region of the cystic and common ducts; (3) quicker and easier recovery of the patient (seven days in bed); (4) fewer complications.

The chief difficulty in subserous cholecystectomy is in control of hemorrhage from numerous small vessels; this can be readily accomplished by the use of modified Cushing silver clips as described:

At about the lower third of the gall-bladder slits are made through the serosa beside the several branches of the cystic artery. The vessels are dissected up and silver clips applied with the clamp for this purpose.

The serosa and vessels are cut across above the clips and the serosa along the vesicular margins.

The gall-bladder is stripped from above to the junction of the cystic and common ducts, which is palpated. The common duct can be explored and drained through the



cystic stump, with a slit into the common duct if necessary.

With the chronic gall-bladder, where a definite, clean stump of cystic duct is doubly tied, and there is no oozing of blood or damage to the liver, drainage is omitted; with the acutely inflamed gall-bladder, drains are used.

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SUBMUCOUS myomas may cause excessive bleeding, anemia and dysmenorrhea without attaining great size.

From—"Diseases of Women" by Paul Titus (National Medical Book Co.).

# ENTEROGENOUS CYSTS

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ANY tissue that has the anatomic structure of an organ, complete or incomplete, must of necessity come from such an organ. Enteric or enterogenous cysts are rare congenital developments from the intestine. They show all criteria of this development with their mucosal epithelial lining in various stages of degeneration, a submucosa, two layers of muscularis and serosa. These cysts contain a mucinous material varying in color from a grayish white to a yellowish brown. The amount of fluid depends on the size of the cysts, which vary from that of a cherry-stone (Heuter's case) to 8200 c.c. (a case reported by Fehleissen).

## CASE REPORT

A female child, age 4 years, was admitted to the Royal Hospital on January 6, 1937, at 8 P.M., with a history of pains in the abdomen associated with frequent vomiting. She had vomited approximately fifteen times since early that morning, and arrived at the hospital in an apparently exhausted condition, with a temperature of 98.6 degrees.

Laboratory findings were as follows:

Blood	
Hemoglobin.....	60 per cent
Erythrocytes per c.mm.....	3,440,000
Leucocytes per c.mm.....	8,400
Poly. neutrophiles.....	87 per cent
Small lymphocytes.....	13 per cent
Urine	
Color.....	Yellow
Appearance.....	Cloudy
Reaction.....	Alkaline
Specific gravity.....	1.030
Albumin.....	Negative
Sugar.....	Negative
Crystals.....	Present
Pus cells.....	Occasional

Examination revealed a well developed female child, with heart normal, lungs clear, and abdomen somewhat distended throughout. A mass apparently the size of a tennis ball, slightly movable and tender, situated in the

right lower quadrant, was observed. Bowel movement had been minimal that morning. No apparent blood was observed by the

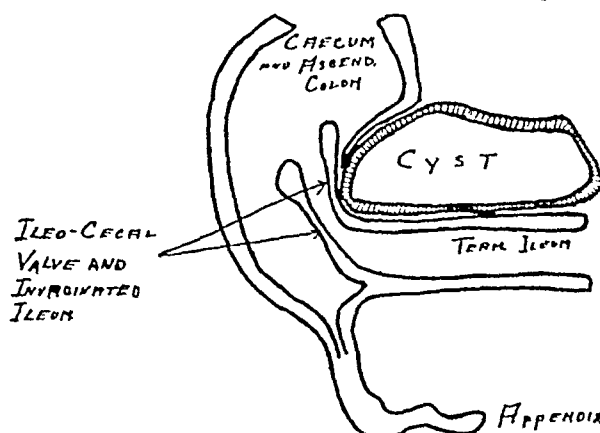


FIG. 1. Diagrammatic gross representation of the pathology.

mother and none was observed on rectal examination at the time of admission. A diagnosis of acute intestinal obstruction associated with intussusception was made and a laparotomy was performed immediately.

**Past History.** The patient had had whooping cough one year previously, but otherwise no early childhood diseases. Six months previous to the present illness the child complained of pain in the stomach associated with cramps and a desire to move her bowels. She vomited once at that time. Three months later there was a typical recurrence of this episode. During her first attack the patient had a bloody stool. During the second attack there was absolutely no stool for twenty-four hours.

**Operative Findings and Procedure.** Post-operative diagnosis was a tumor of the ileocecal junction, with questionable malignancy. Pre-operative diagnosis was acute intussusception.

Gross findings were a cone-shaped mass, cystic, the size of a large lemon, situated at the junction of the ileum and ascending colon between the leaves of the mesentery. A number of smooth mesenteric lymph glands extended upwards and medially towards the liver.

A 4 inch right mid-rectus incision was made through the peritoneum, and the above

pathology was then identified. Two inches proximal to the ileocecal junction the ileum was clamped, cut across and inverted under

"The cyst is pear-shaped and very tense, and its contents cannot be expressed into the lumen of the bowel. The serosal surface

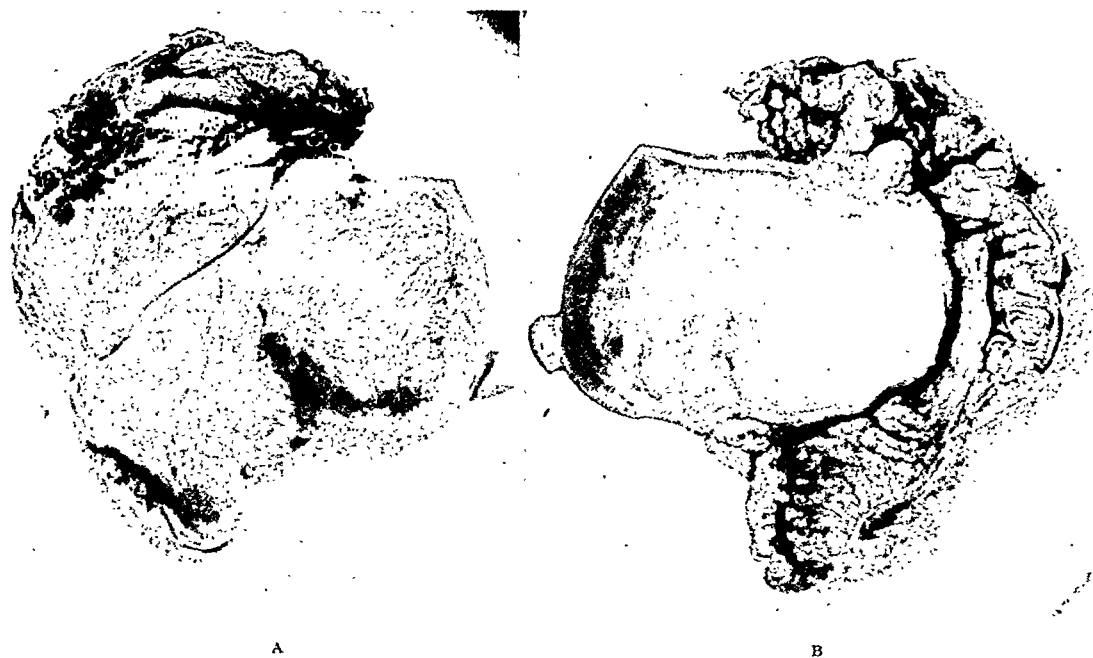


FIG. 2. Pericecal cyst, anterior half, cut section and surface views. A, anterior surface and B, cut section. The ileocecal valve is clearly seen to the right of the cyst, about one-fourth inch above its middle. The ileum enters below and the ascending colon emerges above. Natural size.

double purse-string linen suture. The peritoneum was incised along the white line of the ascending colon; the ascending colon and hepatic flexure were freed, with the posterior parietal peritoneum and glands intact. The transverse colon was grasped just beyond the bend of the hepatic flexure, cut between clamps and inverted under a double purse-string linen suture. The tumor mass with the colon was removed intact; a lateral anastomosis was established between the ileum and the transverse colon. A cigarette drain was inserted to the right lumbar gutter. After all sponges and lap pads had been accounted for, the incision was closed in layers.

*Pathologic Examination by Dr. Joseph C. Ebrlich.*

"*Type of Specimen:* Appendix and portion of bowel, lymph nodes.

"*Gross Findings:* Specimen consists of the terminal inch of ileum and cecum and ascending colon for a distance of 2 inches. A coiled appendix  $2\frac{1}{2}$  inches long is present in the normal location. In the angle formed by the superior surface of the terminal ileum and medial surface of the ascending colon there is a cyst which measures  $2\frac{1}{2} \times 1\frac{1}{4} \times 1\frac{3}{4}$  inches.

of the cyst is markedly injected and the wall of the cyst is thick and firm and fibrous in consistency. The cyst contains about 35 c.c. of fluid of the appearance and consistency of glycerine. The cyst lining consists of shiny, smooth, grayish-white membrane. The cyst has a single cavity with one or two small, valve-like pockets which have blind endings. There are some petechial hemorrhages present in the lining of the cyst. This cyst has produced marked pressure on the ileocecal valve, which is flattened out against the lateral wall of the cecum and which has been invaginated with a small portion of the terminal ileum into the cecum for a distance of 1 inch.

"The muscular and mucosal coats of the ileum and cecum and ascending colon do not show any changes, except for some hypertrophy. The nature of the pressure on the ileocecal valve is such as could produce partial intestinal obstruction. The appendix is essentially normal in appearance, except for moderate serosal congestion. Two lymph nodes were also received, each about 1 cm. in diameter, and were sent through for microscopic examination.

"*Microscopic Findings:* Section of the cyst reveals it to be lined by markedly thinned out

and flattened mucosa of the intestinal type, which, from the clusters of mucous cells present, appears to belong to the large intestine. There

range. She was discharged on the nineteenth day postoperatively.

During her illness at the hospital the pa-



A



B

FIG. 3. Pericecal cyst, posterior half, cut section and surface views. A, cut section and B, posterior surface. The appendix is seen clearly in the surface view. Only a small portion is visible in the cut section view. Natural size.

is a muscular coat which is typical of intestinal muscularis and also a thin serosal coat of the type belonging to intestinal wall. The adjacent ileum contains numerous very large lymphatic cell collections with germinal centers which belong to Peyer's patch. The wall of the colon appears normal.

"Section of lymph nodes of the mesentery reveals hyperplastic nodes with numerous large germinal centers. No definite active inflammation is present.

"Section of appendix reveals some lymphoid hyperplasia.

"*Diagnosis:* (1) Terminal ileum and cecum with closed off congenital intestinal diverticulum in the ileocecal angle, producing partial obstruction at the ileocecal valve. (2) Lymphoid hyperplasia of appendix. (3) Hyperplastic lymph nodes."

Postoperatively the patient had a very stormy course for the first five days, with temperature elevated to 106 degrees and pulse between 140 and 160. A number of infusions were given but no transfusions because of the exceedingly high temperature. The patient finally rallied and from the sixth day on, her temperature came down within the normal

tient lost 15 pounds. From January 23, 1937 to February 9, 1937, she regained about 3 pounds.

#### DEVELOPMENT OF ENTEROGENOUS CYSTS

*Site of Development.* Enterogenous cysts have been found in the thorax and in the abdominal cavities, apparently developed from the esophagus, stomach, duodenum, jejunum, ileum, or sigmoid. Two very rare cases, reported by McLanahan and Stone, apparently developed from the rectum. Cases are on record where in the same individual a thoracic and an abdominal cyst have been found. The most common site of enteric cysts is in the cecal area, but they are also to be found in the duodenum and jejunum. These cysts may occupy any part of the intestinal wall: the submucosa, the musculature or the subperitoneum. They may occupy any plane of the gut either antimesenteric or mesenteric. In the latter position they may be closely approximated to the gut wall or some dis-

tance from it between the leaves of the mesentery. The cysts which are found a distance away from the wall of the gut may find their

opment. In a 23 mm. human embryo they found thirty-three well developed diverticuli in the small intestine. From

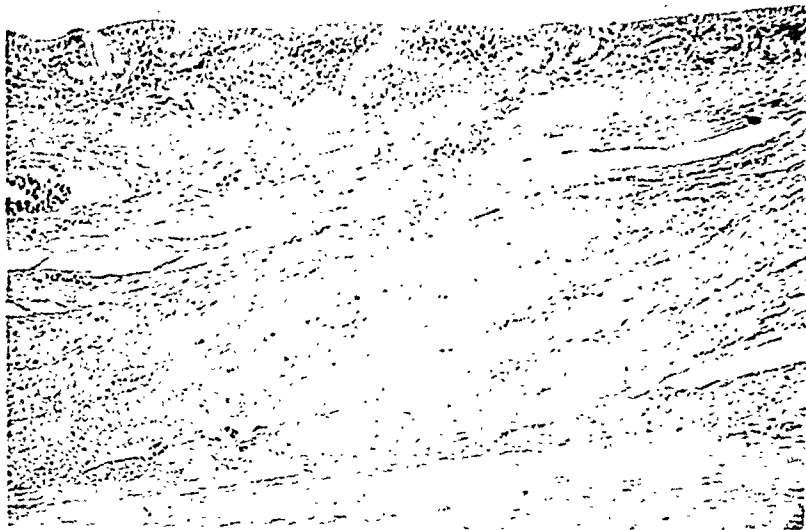


FIG. 4. Cyst lining and wall under low power. The epithelium is stretched out intestinal mucosa. Glandular structures still persist. There is a distinct submucosa and muscularis present.

attachment by fibrous bands to the liver or to some other organ.

*Theories of Development.* Of great importance in our knowledge of the theory of development of these cysts is the understanding that congenital intestinal diverticuli and enterogenous cysts have the same anatomic structure. Their difference lies in the fact that diverticuli communicate with the lumen of the gut while cysts do not.

Lewis and Thyng, in a study of the intestinal diverticuli in the embryo of the pig, rabbit and man, demonstrated knob-like diverticuli in the duodenal region in a 5.5 mm. to 14 mm. pig and also found such diverticuli in the small intestine in the 14 to 24 mm. pig. In a 32 mm. pig, they demonstrated a number of diverticuli in the ileum. These diverticuli, which appear first in the duodenum, begin as round knobs and many elongate and detach themselves from the intestine in the form of nodules, strands or cysts. The rabbit embryo shows practically the same devel-

this development, it is readily conceived how the lumen of a diverticulum may close and obliterate its communication with the bowel and form an enteric cyst. From this development one may understand how enterogenous cysts may occupy any portion of the intestinal wall or any of its planes, or even how they may develop in between the mesenteric folds a distance away from the original host.

There are cysts or diverticuli which arise in connection with the obliterated portion of the vitello-intestinal duct. This theory is probably the most popular among pathologists, and was first advocated by Fitz in 1884. At the end of the fourth week of intra-uterine life the midgut has become tubular and communicates with the yolk sac. At the end of the sixth week the vitello-intestinal duct and the accompanying vessels of the superior mesentery atrophy. A true Meckel's diverticulum, usually situated 12 to 14 inches from the ileocecal valve, develops from such an incomplete obliteration of this duct on the

anti-mesenteric side of the bowel. Remnants of the vitello-intestinal duct may remain between the intestine and umbili-

intestinal morphology. In these structures the greatest variations or changes occur in the epithelial lining. These may show



FIG. 5. Cyst lining under medium power. The mucosal epithelium is of the tall columnar type, with basal nuclei and secretory droplets. The submucosa and muscularis are clearly seen.

cus. Cysts may form anywhere along these points or diverticuli with cysts may develop along the same route. As has been said before, the most popular theories state that all enterogenous cysts develop from the improper obliteration of the vitello-intestinal duct.

Edwards (quoting Gfeller) regards the cysts as arising in connection with an unobliterated omphalo-mesenteric duct, either by separation of a part of the intestinal anlage or by germinal displacement.

Terrier and Lecène mentioned that they might be produced by snipping off, pinching or incarceration of a piece of intestinal wall during early fetal life. It is a well known fact that aberrant Wolffian and other cysts occur in this manner and are found a great distance from their parent structures. Black and Benjamin also take note of this fact.

*Cyst Lining Variation.* On the whole in enteric cysts and diverticuli the entire structure from mucosa, submucosa, muscularis and serosa can be identified as

stratified cylindrical cells, atrophic columnar, stretched columnar, flattened, etc. Formation of villi may be complete or incomplete. These changes, according to Evans, can be accounted for by the intracystic tension or inflammatory changes, or may be explained by the embryologic development of the gut.

*Heterogenous Cysts.* Kollman stated that the epithelium of developing intestine undergoes regular progression from simple cuboidal to simple cylindrical to stratified epithelium from which finally develops the permanent layer of simple cylindrical epithelium. What determines this steady progression to a state of specialized epithelium is not known. In detached epithelium under different environment many various factors may either stimulate or inhibit these cells and give an altogether different cell formation from its original specialized form. For example, time and again gastric cells have been demonstrated in Meckel's diverticuli and esophageal cysts. Gfeller reported a case where he

found several varieties of cells in the same enterogenous abnormality. Black and Benjamin report a case in a 5½ month male child who died of a peptic ulcer at the site of the diverticulum in the proximal connection with the jejunum.

**Reduplication.** On close analysis of the literature the fact develops that this phenomenon undoubtedly is no different from the development of diverticuli. In fact, it is comparable to the formation of giant diverticuli growing between the leaves of the mesentery in close proximity to normal gut wall—thus, in such a position, partaking of part of its blood supply. According to Fitz it is the result of the persistent growth of the vitelline duct.

**Symptoms.** Cysts and diverticuli are found in any age from infancy to senility. The symptoms naturally depend on the age, size and site of the growth. Most often these tumors have been found at autopsy or accidentally at some operative procedure and have been shown never to have produced any untoward symptoms during life.

The symptoms are usually those of local pressure, giving pains or aches, with signs of intestinal obstruction, either through direct compression or from kinking of the bowel by its own weight or its twisting as in volvulus.

**Differential Diagnosis.** The correct diagnosis preoperatively is most unusual. In the child with a mass in the right lower quadrant the diagnosis between acute appendicitis and intussusception is most often considered. Acute intestinal obstruction is the next most common diagnosis.

#### Treatment.

1. The operation of choice is enucleation of the cyst. This is most often possible when the cysts are situated in the mesentery or retroperitoneally a good distance from the gut.

2. The second choice would be excision of the bowel, as in my case, with anastomosis. Here the mortality is usually very high because such an extensive operation has to be performed in the early span of life.

3. In very large cysts, marsupialization may be a method of choice, especially where the mass is so large that enucleation or anastomosis is not feasible or where the general condition of the patient is precarious.

#### SUMMARY

This case of an enteric cyst is presented, first because of its extreme rarity, and second for the many interesting theories of development that can be followed from the embryologic state to the pathologic culmination.

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## CARBUNCLE\*

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THE skin offers a remarkable protection for us and bears the brunt of our contacts with trauma and micro-organisms. Its immunity must be high and its reparative powers great or we should soon be annihilated, since the integument is constantly covered with bacteria. It contains many natural pits (sebaceous gland ducts, hair follicles, sweat gland ducts) to say nothing of those artificially created by injury. If these pits become closed, ample opportunity is present for the development of the familiar boil or carbuncle. It is well known that even after careful preparation of the skin for operation it remains grossly contaminated, for it is impossible and perhaps unwise to attempt complete sterilization.

Our study of carbuncle consists in: (1) a brief review of the microscopic anatomy of the skin and subcutaneous tissues on the neck and face in order that we may understand the paths which these infections may take; (2) a study of the immunology which permits the infection to occur and which finally overcomes it (local and general); (3) the surgical pathology which is manifested; and finally (4) the proper treatment in the light of clinical and statistical studies of different methods and their results.

A study of the low power photomicrograph of a section of normal skin taken from the back of the neck will show the depth of the hair follicles, sebaceous glands and sweat glands. It will be seen that they descend down into the subcutaneous tissue, but not into the subcutaneous fat. According to Warren:<sup>1</sup> "There would be no communication with the subcutaneous adipose tissue were it not for oblique columns of fatty tissue which extend upwards from

below. These fat columns or columnae adiposae which are found beneath each hair follicle are of about the same width as the hair follicle—and they contain besides loose connective tissue, fat cells and vessels, the coil of a sweat gland suspended midway in the shaft." These columns then complete the pathway from the hair follicle through the subcutaneous fat down to the underlying fascia. (Figs. 1 and 2.)

Infection occurs as a result of a decreased local immunity plus the occlusion by sebaceous material, dirt or grease of the normal skin pits. The staphylococci multiply rapidly and soon a papule forms. At this stage a small area of necrosis is present (caused by toxins from the bacteria) surrounded by a zone of inflammation. Here the process may stop and resolution may occur, particularly if the obstruction is removed, either spontaneously or by the use of ether or other fat solvent. If the bacteria continue to multiply further, necrosis occurs, which calls forth more inflammation and which is followed by suppuration.

It is easily seen that when pus forms and goes down the columns of Warren, it cannot easily spread to the sides; it therefore goes deeper until some of it reaches the deep fascia whence it burrows along, finally seeking an outlet by ascending along other columns. (Fig. 2.) A sponge-like arrangement is thereby created with the "spaces" of the sponge filled with pus. Numerous exits are finally established in the skin, giving rise to its multiple draining sinuses.

On the face, the skin is also firmly attached to the underlying structure (panniculus carnosus or platysma in the neck) which continues upward as the muscles of

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expression. There is very little subcutaneous fatty tissue and the muscles are not involved. (Muscle tissue does not become

antibodies, and it is this combination that stems the progress of bacterial action. For inflammation, repair and immunity are not

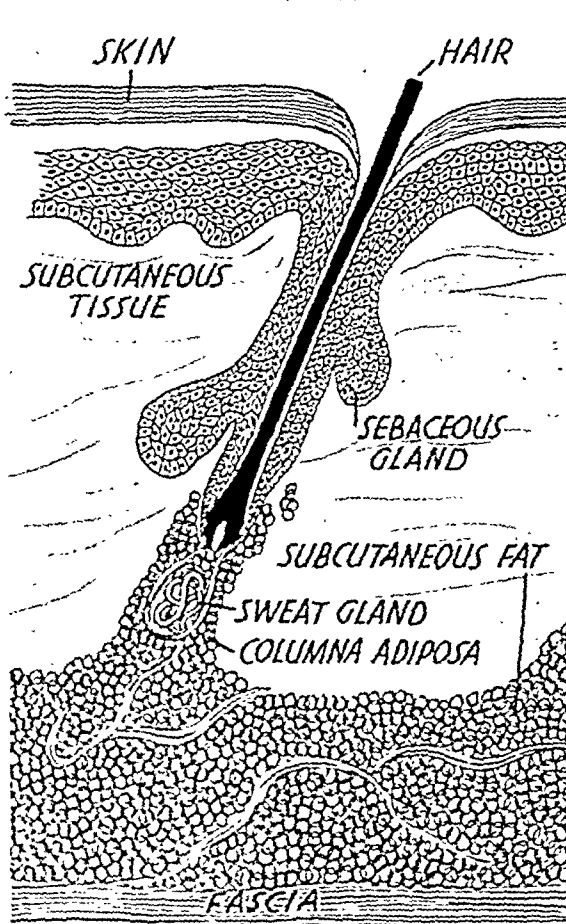


FIG. 1. Diagram illustrating hair follicle and column adiposa.

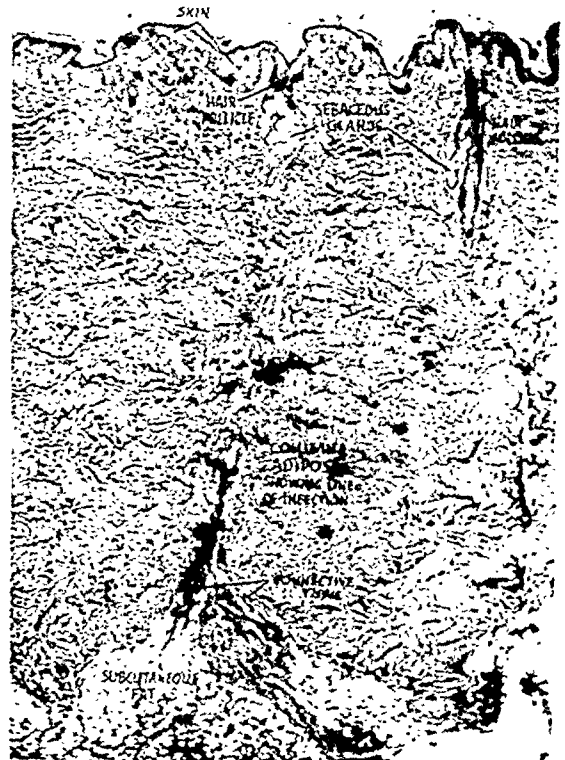


FIG. 2. Low power photomicrograph taken from a patient with carbuncle of the neck. Note how the infection descends from the hair follicle down the column adiposa into the subcutaneous fat.

infected unless injured or devitalized.) Consequently, pus does not break through into the mouth cavity or down to bone, but spreads laterally under pressure, causing phlebitis and thrombosis of veins and necrosis of the overlying skin. (Fig. 3.)

Since carbuncle is the result of a staphylococcal infection, an attempt is made at localization. This process is the same as occurs in all localized (as opposed to diffuse) inflammations. The wall that ultimately forms is a thick, living "pyogenic membrane" loaded with leucocytes, histiocytes, endothelial cells and fibroblasts. It is full of cellular immune bodies (the front lines of immunity), augmented by humoral

the same processes and as long as infection persists, the forces of repair may attempt the formation of healthy granulation tissue, but this is soon destroyed by the bacterial toxins. It is only after immunity has occurred and the invading organisms annihilated that healthy granulations are laid down, and repair by second intention occurs. This is the process that takes place in the simple boil as well as in the compound series of boils, the carbuncle. The method of spread is no doubt by tissue contiguity down between the fibrous septa of the subcutaneous tissue. The manner in which these localizing infections are handled has been carefully worked out. The ninth day after infection, there is a thrombosis of the lymphatics to the part, and colloids, such as india ink, injected

into the cavity, are no longer found in the neighboring lymph glands. After the sixth day this same cavity is impermeable to crystalloids. In carbuncle, although new tissue is invaded, this same process is set up with each new zone until finally the entire area is "walled-in." (Fig. 4.)

To help us arrive at the proper method of treatment, we studied 125 cases of severe carbuncle. This did not include an equal or even greater number of small carbuncles treated in our office or in the out-patient departments. It may be said in passing, however, that all of the latter were treated conservatively—the only surgery done was without anesthesia and consisted in connecting sinuses by incision and lifting out sloughs. (Fig. 5.) There were no deaths in this group.

Of the severe carbuncles eighty-three were in males and forty-two in females. Most occurred on the back of the neck (Chart I) in both men and women, but

CHART I  
ANATOMIC AREA INVOLVED

	Males		Females		Total	
	No.	Per Cent	No.	Per Cent	No.	Per Cent
Neck.....	50	60.2	19	45.2	69	55.2
Extremities.....	15	18.0	10	21.4	25	20.0
Body.....	10	12.0	7	16.6	17	13.6
Face.....	5	6.0	5	11.9	10	8.0
Scalp.....	3	3.6	1	2.3	4	3.2

carbuncle occurred twice as commonly on the face of women, whereas, it was more common on the scalp of men. The face is a dangerous place, for four of the nine deaths occurred in facial carbuncle. The ages varied from 4 years to 80 years with the average age 48.3 years. Contrary to popular opinion, most patients (69 per cent) had no general associated disease, but of those who did diabetes was most common. (Chart II.) Particularly is this true of females, 76 per cent of whom were normal. (Is this due to picking and squeezing of pimples?) How-

ever, when carbuncle does occur in the debilitated it is apt to be more serious.

The type treatment studied may be

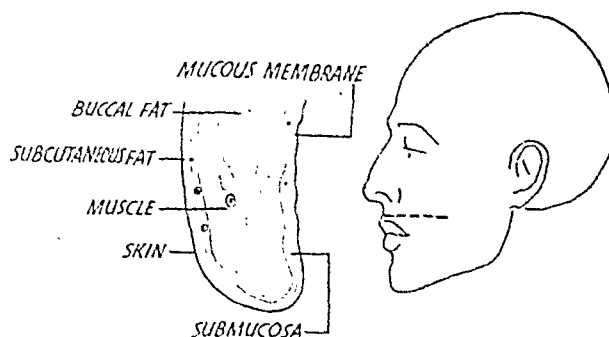


FIG. 3. Diagram of cross section of the cheek. The skin lies on a thin layer of subcutaneous fat which in turn is attached to the muscles of expression without intervening fascia. Small veins which anastomose freely in this area may easily become the seat of thrombophlebitis and cause an ascending infection via the superior ophthalmic vein (which is devoid of valves) into the cavernous sinus. The diagram on the right indicates the area from which the section was cut.

divided into: (1) excisions, by which is meant the complete extirpation of the lesion; (2) incision with or without removal

CHART II  
ASSOCIATED DISEASES

	Male, Per Cent	Female, Per Cent
None.....	67.4	76.1
Diabetes.....	18	14.2
Miscellaneous*.....	4.6	9.7

\* Miscellaneous includes: nephritis, multiple fractures, otitis media, pneumonia, erysipelas, syphilis, carcinoma of the breast, tuberculosis, severe burn, thyrotoxicosis, atrophic arthritis, prostatic hypertrophy, cerebral hemorrhage and pyemia.

of necrotic tissue; and (3) conservative treatment which includes x-ray, serum injection, ultra-violet ray, magnesium sulphate packs, various antiseptics, etc. Conservative treatment was used in 20 per cent of the cases and half of these had serious associated conditions. (Chart III.) Incision was used in thirty-two patient (26 per cent) and of these fifteen (or 46.8 per cent) had associated conditions. Excision was em-

ployed in sixty-seven patients (54 per cent); of these ten (14.9 per cent) had associated conditions. It is readily seen that con-

treated by incision is almost as great, and yet only one death occurred.

The indications for treatment must be

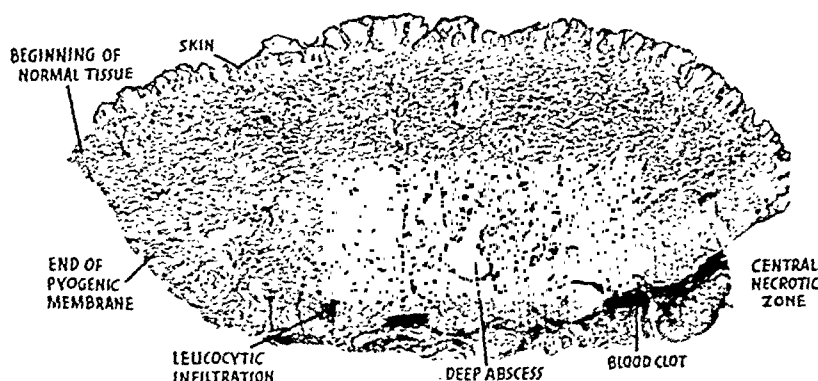


FIG. 4. Low power photomicrograph taken from a patient with carbuncle of the neck. This section extends from the center of the carbuncle to the outer edge. Note the wide area of leucocytic infiltration. The epidermis is viable.

servative treatment and incision were the treatment of choice in those most seriously ill.

obvious from the above discussion. They may be dogmatically stated as follows: first, wait for localization; second, drain as

CHART III  
METHOD OF TREATMENT

	Total		With Associated Conditions		Without	
	No.	Per Cent	No.	Per Cent	No.	Per Cent
Conservative.....	26	20	13	50	13	50
Incision.....	32	26	15	46.8	17	53.1
Excision.....	67	54	10	14.9	57	85

CHART IV  
TREATMENT AND MORTALITY

Treatment	No.	Per Cent	Mortality in Those without Associated Conditions		Mortality in Those with Associated Conditions		General Mortality	
			No.	Per Cent	No.	Per Cent	No.	Per Cent
Conservative.....	26	20	0	0	5	19	5	4
Incision.....	32	26	0	0	1	3	1	0.8
Excision.....	67	54	1	1.5	2	3	3	2.4
Total cases.....	125	..	2	1.1	8	21	9	7.2

However, when we look at Chart iv, the mortality figures are indeed instructive. There were nine deaths. Eight of the nine (or 88.8 per cent) occurred in patients with severe illness. Six were diabetics, one had a cavernous sinus thrombosis and one had erysipelas and pneumonia. This chart further reveals that the highest death rate occurred when conservative treatment was used. This is misleading because these patients were thought to be too sick for any form of surgical treatment. On the other hand, the percentage of seriously sick

adequately as possible; third, remove foreign bodies, which, in carbuncle, are the necrotic tissue; fourth, obliterate dead space by allowing granulations to form from the "bottom up"; fifth, supply rest to the part; and sixth, treat the individual as a whole, as in diabetes, etc. These general rules may be applied to any abscess, but in carbuncle several important facts must be further discussed.

Anyone who has made a study of this lesion will agree with the first fundamental law in the treatment; namely, wait for

localization. This implies the establishment of local immunity and any form of surgical treatment prior to this simply defeats all the magnificent efforts of nature and causes the infection to spread.

Drainage is also necessary, but the best method of obtaining this, we believe, depends upon two very important factors. The first of these is the location of the lesion. From the standpoint of natural or surgical drainage there are two kinds of carbuncle—facial or otherwise. If it is the former, surgical drainage is contraindicated. This agrees with the advice of Mitchiner and others.<sup>4</sup> Deep abscesses are not present, sloughs are relatively superficial, and the extreme danger of a spreading thrombophlebitis up the angular vein into the superior ophthalmic vein (which is devoid of valves) into the cavernous sinus, makes natural drainage (coupled with the slight help described below) the treatment of choice. The bad cosmetic effect of surgical intervention is an added important objection.<sup>9</sup> The second factor is the general condition of the patient. If there is severe diabetes present, for example, natural drainage or conservative management is advisable, together with specific care of the diabetes. Certainly these patients stand anesthesia poorly, and any surgery may cause a fatal thrombus or embolus or may stir up a bacteremia or pyemia of fatal import. As was previously pointed out, eight of the nine deaths occurred in patients with diabetes or other severe illness and seven of these patients died of general bacteremia. A study of Chart IV might seem to contraindicate this advice at first sight. However, it should be remembered that of the twenty-six cases treated conservatively, Chart III shows that 50 percent were patients with severe systemic disease.

The term conservative is variously interpreted by many surgeons. Such measures as hot hypertonic packs, x-ray,<sup>6</sup> Bier's<sup>7</sup> suction, MgSO<sub>4</sub> and glycerine, injections of serum about the carbuncle, diathermy, various antiseptics, ultra-violet ray, colloidion treatment<sup>8</sup> all have their strong advocates. However, we use the term to

mean first rest in bed, with ample sedation to relieve pain, careful attention to fluids, food and elimination, and attention to

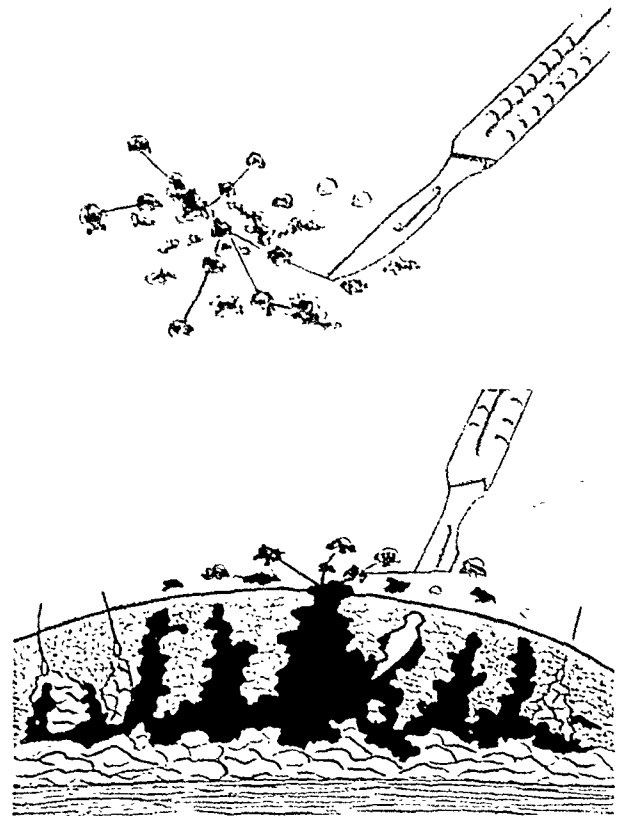


FIG. 5. Method of securing drainage in patients with carbuncle of face or with severe systemic disease. The draining sinuses are connected by incisions as shown. This is done in stages after localization. By this method anesthesia is unnecessary and ample drainage is provided. Sloughs are removed as soon as they separate.

diabetes if present. Locally, dry or moist heat for the comfort of the patient may be used, but always as little meddling as possible. As the skin becomes necrotic and multiple sinuses develop, their apertures may be connected painlessly in separate stages by incision without anesthesia, and loose sloughs may be lifted out. (Fig. 5.) In several cases x-ray has been used and we believe with some help.

If the carbuncle is not facial and not in a severely sick patient, surgical drainage by excision or incision may be used. Mitchiner,<sup>4</sup> Love,<sup>3</sup> and many others prefer excision. They show less mortality and greater freedom from recurrence, shortening of time and less pain. Others prefer incision with undercutting.<sup>2</sup> Our studies reveal that

either method is safe in this group. We believe that excision is safe because of the extremely wide "pyogenic membrane" in

lifted and sterile vaseline gauze is inserted under them. After three or four days it is removed, and irrigations with normal salt



FIG. 6. A, left half of carbuncle "excised," right half "incised" according to the method described in the text. B, two weeks later.

carbuncle and that even in "wide" excision, so-called, this wall is rarely transcended. Should the excised area go beyond this zone, the infection may invade adjacent tissues and the end result will be a huge raw area, with possible development of septicemia. (Chart iv.)

In an effort to test the efficacy of the two methods, a large carbuncle was treated in both ways simultaneously. (Fig. 6.) Half was excised, staying within the inflammatory zone, the other half incised and the flaps undercut. It will be seen that the flaps remained viable and were really pedicle flap grafts causing this side to heal in a much shorter time, although the excised half healed satisfactorily later. We have repeated this experiment in three other cases with the same result. Sometimes a pedicle undergoes necrosis; should this occur it can be removed without anesthesia.

The secret of successful incision is based upon undercutting. This is necessary if the many small abscess cavities are to be evacuated. Following this the flaps are

are given every two or three days. In our experience there is little difference between the use of antiseptics and normal saline. This agrees with the recent work of Smelo.<sup>10</sup> Incision conserves tissue<sup>2</sup> whereas the undercutting gives adequate drainage. It is easily and quickly done with minimal anesthesia and minimal trauma. On the extremities where tendons or nerves may be injured it is the treatment of choice.<sup>5</sup> Our studies show that the general mortality with this treatment is 0.8 per cent as opposed to 2.4 per cent for excision. Because of the preservation of skin attached by a broad base, living grafts are preserved and healing is facilitated. In the University Hospitals, patients treated by conservative management required the longest period of hospitalization. Many of the patients who were treated by excision of the carbuncle required subsequent skin grafts. Those treated by incision remain the shortest length of time.

The removal of cellular debris, which is our third rule, is accomplished easily in all methods of treatment. In conservative

cases, the sloughs are removed as they separate without anesthesia, as previously described. With surgical methods, necrotic tissue is removed at the same time that drainage is provided. The fourth requirement is satisfied by judicious observation and, when incision is used, by a short period of packing followed by occasional irrigations. Rest to the part in severe carbuncle usually implies rest in bed and this varies with the time necessary for localization and the type of treatment required. Patients with severe systemic disease obviously require intensive treatment, for immunity and repair depend ultimately upon the general condition of the patient.

#### CONCLUSIONS

1. A study of the microscopic anatomy of the skin on the back of the neck and on the face clearly explains the behavior of this lesion and definitely establishes carbuncle of the face as a distinct entity.

2. A statistical survey of carbuncle reveals the following information concerning occurrence:

- (a) Most carbuncles occur on the neck in both sexes, but are more frequent on the face in women than in men.
- (b) Most carbuncles occur in patients without debilitating disease; this is more noticeable in women than men.
- (c) Both of the above observations lead to the conclusion that "picking" of skin infections is an important causative factor.
- (d) Of all associated diseases, diabetes is most frequent.
- (e) When the carbuncle occurs in patients with debilitating disease or on the face, it is more serious.

3. A statistical study of treatment and mortality rates leads to the following deductions:

- (a) Carbuncle of the face is the most serious, causing 45 per cent of the deaths encountered.

Reasons are given for treating such lesions conservatively. The general mortality in facial carbuncle was 40 per cent.

- (b) Carbuncle elsewhere on the body, associated with severe debilitating disease, must also be treated conservatively. Five of the nine deaths occurred in this group. The general mortality was 18 per cent.
- (c) Carbuncle not on the face and not associated with severe disease should be treated by surgical intervention. This may be by excision or incision. The general mortality in this group was 1 per cent.

4. Statistical and experimental observations point to incision with undercutting as the operation of choice because:

- (a) The mortality is much less (.8 per cent as against 2.4 per cent).
- (b) There is quicker healing due to the preservation of viable skin flaps.
- (c) There is no necessity for subsequent skin grafting.
- (d) The period of hospitalization is shortened.

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# THE PHYSIOLOGIC BASIS FOR LIGATION OF THE GREAT SAPHENOUS VEIN IN THE TREATMENT OF VARICOSE VEINS\*

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MANY additional surgical procedures, some of them very elaborate, have been proposed for the correction of varicose veins since Trendelenburg's original suggestion in 1890<sup>1</sup> that they be treated by ligation of the saphenous vein. The Trendelenburg operation, however, has stood the test of time, and properly so, for there is no simpler and more direct mode of attack upon this very common and highly disabling condition. Trendelenburg proposed that the great saphenous vein be ligated at the junction of the middle and lower third of the thigh. Homans<sup>2</sup> in 1916 and Edwards<sup>2</sup> in 1936 proposed, instead of ligation at this point, ligation of the vein and all its terminal branches at the saphenofemoral junction, and this is the single important modification of Trendelenburg's original procedure which has so far been suggested. Today, the standard method of treatment for varicose veins associated with incompetency of the valves of the saphenous vein is high ligation of that vein, followed by the injection of some sclerosing substance.

Trendelenburg's conception of the altered physiology present in varicose veins has been little changed by the passage of years. As he pointed out in his original paper, the essential pathologic change is a reversal of the normal blood flow. The blood flows downward in the varicosity through the communicating vessels into the deeper circulation instead of toward the heart, as normally. He believed, and his idea has been very generally accepted, that ligation of the saphenous vein corrected the reversal of the blood flow and also corrected the back pressure presumably asso-

ciated with it. But this new concept has remained merely a concept. It has never been established, nor, so far as we know, has any study ever been undertaken to determine exactly what circulatory changes occur after ligation of the saphenous vein, or to demonstrate the supposed alterations in venous pressure which this procedure achieves. Such a study we have ourselves undertaken on twenty-one patients, all of whom had marked varicosities of the leg; all presented an adequate deep venous return and all presented positive Trendelenburg tests.

The first part of the study was carried out upon eleven patients and was devoted to a determination of the venous pressure before and after ligation of the saphenous vein. The examinations were made while the patients were in the standing position, by means of an 18 gauge needle attached to a U-tube mercury manometer. The venous pressures of the popliteal vein and of the varicosities at the same level and at the ankle joint were determined and recorded before the saphenous vein was ligated, and immediately afterward. As Table 1 shows, the pressure in the popliteal vein was always lower than the pressure in the varicosities at the same level both before and after the saphenous vein was ligated, with the exception of one case, in which the pressure was equal in the popliteal vein and in the varicosities at the same level. The pressure changes varied, it is true, sometimes rising and sometimes falling, but there was always a clear tendency toward rapid readjustment. It may fairly be concluded, therefore, that the concept so long accepted is erroneous,

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and that pressure changes play no important part in such results as are achieved by ligation of the saphenous vein.

injected it does not cause pain or produce avascular damage. It is slightly heavier than blood and so is readily miscible

TABLE I

Comparison of pressure in deep veins & superficial varicosities before and after ligation of the saphenous vein						
Case	Before ligation of saphenous vein			After ligation of saphenous vein		
	Popliteal Vein	Varicose Vein at knee	Ankle	Popliteal Vein	Varicose Vein at knee	Ankle
1	46 mm Hg.	56 mm Hg.	70 mm Hg.	40 mm Hg.	48 mm Hg.	86 mm Hg.
2	50 mm Hg.	60 mm Hg.	80 mm Hg.	42 mm Hg.	58 mm Hg.	88 mm Hg.
3	58 mm Hg.	62 mm Hg.	86 mm Hg.	58 mm Hg.	60 mm Hg.	84 mm Hg.
4	58 mm Hg.	62 mm Hg.	80 mm Hg.	56 mm Hg.	58 mm Hg.	
5	60 mm Hg.	60 mm Hg.		56 mm Hg.	70 mm Hg.	
6	46 mm Hg.	48 mm Hg.		40 mm Hg.	44 mm Hg.	
7		54 mm Hg.			56 mm Hg.	
8		66 mm Hg.			66 mm Hg.	
9		40 mm Hg.			54 mm Hg.	
10		76 mm Hg.			54 mm Hg.	
11		40 mm Hg.			56 mm Hg.	

The second part of the study was carried out upon ten patients, and was devoted to a determination of the direction of the blood flow in the varicosities before and after ligation of the saphenous vein, as well as to the relative rate of emptying time in them before and after ligation. The reversal of the blood flow, which is the fundamental pathologic change in varicose veins, had been visually demonstrated by McPheeters and others, but we are aware of no attempt to determine what changes in the direction and rate of flow occur after ligation.

Our studies were carried out with stabilized thorium dioxide, an agent which we have been using for the past four years for the visualization of the peripheral blood vessels, and which we have found eminently satisfactory. When properly

with it, but it is not so heavy that it gravitates downward from its mere weight. Figure 1C demonstrates this point very clearly; the solution was injected into the popliteal vein while the patient was standing, yet in spite of the upright position it is ascending the venous channel, as the venous flow is normally upward in this location.

Our technique in this study was very simple. The patient stood upright on the table against the fluoroscopic screen. Four c.c. of stabilized thorium dioxide was injected into the varicosities about 3 inches above the knee, and then, while the patient remained absolutely immobile, the downward direction of the flow was noted. (Fig. 1A.) Repeated observations were made until the solution had completely disappeared from the varicosities. It was noted that the opaque medium always



descended rapidly in the varicosities and disappeared into the communicating and deep veins, the time required for its final second injection. Immediately after the injection the opaque solution whirled about the point of injection; then part of it

TABLE II  
Rate of flow of opaque medium from varicosities  
before and after ligation of saphenous vein

	4cc before ligation	4cc after ligation
Case 1	Disappeared—3 min.	Still present 15 min
Case 2	Disappeared 1½ min.	Still present 8 min.
Case 3	Disappeared 4½ min.	Still present 8 min.
Case 4	Disappeared 5 min.	Still present 12 min.
Case 5	Disappeared 3 min.	Trace 7½ min.
Case 6	Disappeared 1½ min.	Trace 10 min.
Case 7	Trace 7 min.	Heavy Trace 15 min.
Case 8	Disappeared 4 min.	Still present 12 min.
Case 9	Faint Trace 4 min.	Heavy Trace 8 min.
Case 10	Disappeared 4 min.	Disappeared 4 min.

disappearance varying from one and a half to seven minutes.

slowly ascended toward the ligated end of the vein and there remained, while part

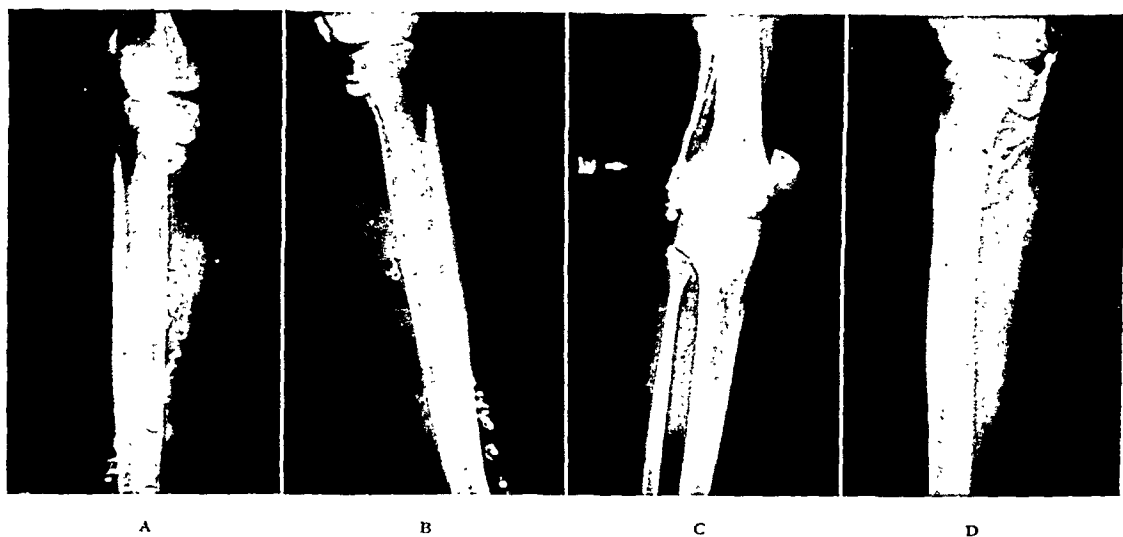


FIG. 1. A, Reverse flow of opaque medium in superficial varicosities before ligation. B, opaque medium descending in varicosities after ligation of the saphenous vein. C, upward flow of opaque medium after injection into the popliteal vein. D, control of the backward flow with use of tourniquet.

Similar fluoroscopic studies were repeated after the ligation of the saphenous vein at the saphenofemoral junction, the same amount (4 c.c.) of the stabilized thorium dioxide solution being used for the

of it slowly descended. As the middle and lower part of the leg was reached, the downward flow became more and more rapid until finally the solution disappeared into the deeper veins. (Fig. 1B.) In other

words, after ligations of the saphenous vein the blood whirled about the point of injection of the opaque substance (3 inches above the knee); near the ligated portion of the vein it remained stationary, while below the knee it descended as before ligation, but at a much slower rate. Marked slowing was noted in all but one of the cases studied. As Table II shows, the time of the disappearance of the thorium dioxide solution varied considerably. The absolute time is not recorded in all cases because the slowing of the circulation was so marked that too many x-ray exposures would have been required to obtain the information.

After we had satisfied ourselves that the rate of blood flow through the varicosities had been markedly slowed after ligation of the saphenous vein, the patient was requested to move his foot and leg as if he were walking. Immediately afterward the opaque solution disappeared, the muscular action apparently being sufficient to produce rapid emptying of the varicosities and rapid descent of the solution at the level of the knee and in the lower leg. In some cases the solution in the upper segment of the vein near the ligated end of the varicosities also descended; in other cases it disappeared by way of the collateral vessels.

Our observations have shown us that before ligation of the saphenous vein the circulation in the varicosities is rapidly downward, the speed of the downward flow depending upon two factors: the volume of blood entering the varicosities and the height of the blood column. When all the valves of the saphenous vein are incompetent, as they were in this selected group of patients, a long column of blood is thus able to flow rapidly through the varicosities and finally backward through the communicating branches and into the deep circulation. (Fig. 2A.) This situation is entirely altered after ligation of the saphenous vein. The weight of the column of blood is removed and the varicosities fill, as do normal vessels, from the super-

ficial tributaries and perhaps from the upper communicating branches, until the pressure in them again reaches a constant

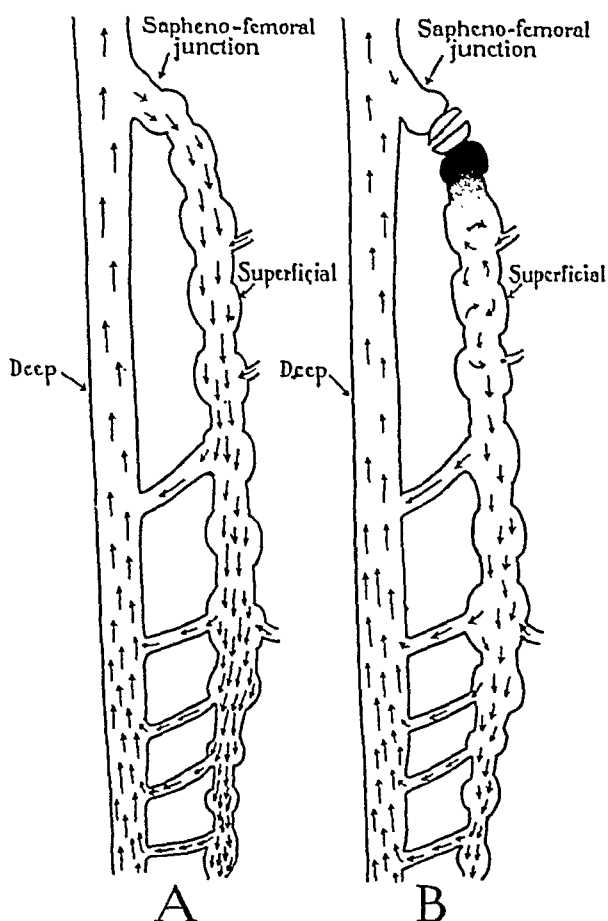


FIG. 2. A, diagrammatic representation of the circulation in the deep veins and varicosities. B, alteration of the circulation after ligation of the saphenous vein. Direction of arrow points in direction of blood flow. The number of arrows indicates rapidity of flow.

level. The pressure in the varicosities remains higher than the deep venous pressure while the patient stands erect, and the blood from the deep venous channels cannot flow through the lower communicating branches into the superficial system. The blood therefore enters the varicosities in smaller amounts from the tributaries, and perhaps from the upper communicating branches, and upward flow is prevented by occlusion of the vein. As the lower leg is reached, the flow is downward and the rate much slower than it was before ligation. (Fig. 2B.)

In a few instances (4 per cent of 261 cases, according to Cooper<sup>5</sup>) the varicosities undergo spontaneous thrombosis after ligation.

tion of the saphenous vein, and no further treatment is required. Usually, however, the introduction of some sclerosing sub-

As the outcome of our studies, we have devised a method of controlling the circulation in the varicosities prior to the injec-

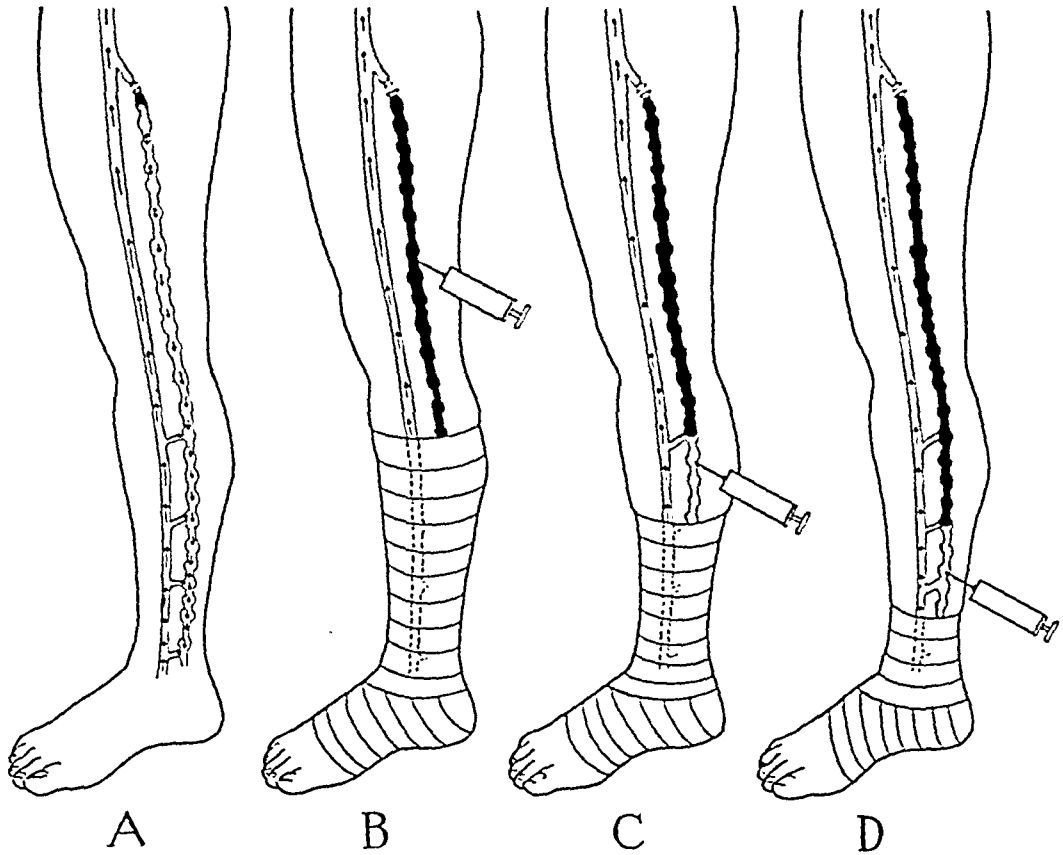


FIG. 3. A, diagrammatic sketch of the alterations in the circulation after ligation of the saphenous vein. B, control of retrograde flow below knee by the use of elastic bandage. Injection of segment of varicosity above bandage. C, lowering of bandage and injection of varicosity. D, further lowering of bandage and injection of varicosity.

stance is also necessary. The rationale of the combined treatment is clear. The simple introduction of a sclerosing agent, which damages the intima of the vessels, is not usually sufficient for the production of thrombosis, for the flow of blood through the varicosities is so rapid that either no clot at all is formed, or the one that is formed does not completely fill the lumen of the vessels and is likely to be rapidly washed away. When to the damage of the intima, however, is added the slowing of the rate of blood flow produced by ligation of the saphenous vein, the circumstances are ideal for the formation of a firm, occluding clot, and a good result can usually be expected.

tion of the sclerosing agent. (Fig. 3.) The saphenous vein and its immediate tributaries are ligated at the saphenofemoral junction, after which, while the patient lies prone, with the extremity elevated, an elastic bandage is applied from the middle of the foot to the tuberosity of the tibia. (Fig. 1B.) Then, while the patient stands, 5 c.c. of sodium morrhuate solution (5 per cent) is injected into the saphenous vein just above the upper level of the bandage. The usual result is a firm clot in the upper segment of the vein. At weekly intervals the bandage is lowered 4 to 6 inches and the injection is repeated. Three or four such treatments usually produce thrombosis of the entire vein. Small venous

pockets are injected later and separately, as the need arises.

This is now our routine treatment for varicosities associated with incompetency of the valves of the saphenous vein. We have amply demonstrated its value as an adjunct to high ligation of the vein, and we have also found it a very satisfactory method for cases in which this vein is not involved. We make no claim to priority, though we have not seen the method described elsewhere, but we do recommend it without reservation to surgeons who are called upon, as we are, to handle a large number of patients in a clinic with limited facilities of space and equipment.

#### SUMMARY

1. By a series of tests, we have demonstrated the physiologic effect of high ligation of the saphenous vein for the correction of varicosities:

(a) The rate of blood flow in the varicosities is slowed.

(b) The blood flow ceases entirely in the upper segment of the ligated vein.

(c) At the point of injection (just above the level of the knee) the blood current whirls slowly, the flow being both upward and downward.

(d) Below the knee the flow is again downward and the rate is much slower than before ligation of the vein.

2. Other studies, by which we have shown that there is a rapid readjustment of the venous pressure in the varicosities, seem to indicate that pressure changes play no part in the beneficial results obtained by ligation of the saphenous vein.

3. By the use of elastic bandages to control the downward flow of blood, the current can be completely stopped. An ideal set of circumstances is thus established for the production of rapid, firm thrombosis following the injection of a sclerosing substance. The method is applicable to cases in which the saphenous vein is not involved as well as to those in which high ligation is necessary. No claim to priority is made for this procedure.

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# THE RATIONALE OF THE SURGICAL TECHNIQUE IN CARCINOMA OF THE RECTUM AND SIGMOID\*

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MANY of the deaths from carcinoma are unnecessary and can be avoided by cooperation between the physician and the specialist. There is one thing that stands out above all others, namely, the routine digital examination. No physical examination is complete without it.

Cooperation between family physician and proctologist would lead to the identification, then the eradication of malignant disease in its early stages when a prospect of cure is almost a certainty. It would also abolish the regrettable practice of labeling cases inoperable when in fact they are for the most part operable in the hands of experts.

It is our propose to discuss only the treatment of well established cases of cancer of the lower bowel, and not the early lesions which may be eradicated by local removal. To that end let us consider the purpose of operation, which is to rehabilitate the patient, i.e., restore the individual to useful life. There must be no invalidism and no neurosis or the operation has not been a complete success, even though the disease may have been completely stamped out. Surgery offers the only means of attaining this result. Irradiation has as yet to prove its place in the treatment of carcinomata of the lower bowel, for although it cannot be denied that many individual cases, in the hands of experts, have been arrested temporarily, and some even appear to have been cured, these instances are too rare to permit consideration of this type of therapy at present.

Sir Charles Gordon-Watson is one of the few eminent surgeons to have thoroughly

investigated radium therapy in cancer of the lower bowel. His experience has been a bitter disappointment to him. From March 1925 to the end of 1931 he had tried this form of therapy on 149 private cases. Since then he has only used it in nine cases. The cases in which he saw fit to use this method were those of the operable type in which surgery was resolutely refused, and in selected inoperable cases. He has also inserted radon seeds into the region of the retrorectal glands at the time of colostomy before excision. One of us had the opportunity, as one of his dressers, to see the sections of many of these tumors. In every case viable malignant cells were found shut in by dense fibrous tissue. Sir Charles himself feels that the main reason for the small percentage of cures with this type of therapy is the fact that it is almost impossible to deliver a sufficiently large dose to the tumor, due to the difficulties of access and the position of the rectum.

As regards x-ray therapy for these cases, Dr. W. Levitt, of St. Bartholomew's Hospital has said: "The treatment of carcinoma of the rectum with deep x-rays still remains unsatisfactory, and in spite of every effort to improve the technique, the results have shown little or no improvement during the past few years. . . . The failure of rectal growths to respond to x-ray treatment would appear to be due mainly to an inherent lack of radio-sensitivity in the essential cell of the growth. That these growths can respond, however, to x-ray treatment when sufficient dosage is administered is suggested by the behavior of the glandular and isolated secondary deposits, . . . which are more

\* Read before the American Proctologic Society, Atlantic City, June 6-9, 1937.

superficially placed than the primary growth, and are thus accessible to more intensive irradiation."

It seems needless to warn of the dangers of the many pseudo-scientific cures which are being popularized in the lay press. However, as we have recently encountered many men of eminence in non-surgical fields who have been led astray by the false promises these so-called cures hold forth, we urge the surgeon never to dismiss such matters with a shrug, but to explain carefully and patiently the falsity of all such claims. There is, of course, no place for diets or serums in the cure of established cancer. Many of these so-called cures not only fail to destroy the growth, but complicate the work of the surgeon who finally has to cope with the condition.

The operation for the eradication of cancer of the lower bowel must be carefully planned. The ideal surgery is that which eradicates the growth and accomplishes rehabilitation of the patient. The next best operation is that in which the diseased tissue is partially eradicated yet there is complete rehabilitation of the patient. The third type completely eradicates the neoplasm but only partially rehabilitates the patient. The fourth type is the palliative operation. Palliative surgery is only justified as a last resort to change the character of impending death.

The choice of operative technique will vary with three factors: (1) with the site and type of the growth; (2) with the individual patient, who must be considered both from the physical and the psychological standpoint; and (3) with the experience and skill of the operator.

Obviously, a growth low down in the rectum will demand a different technique from one high in the sigmoid. Also, the degree of fixation and infiltration will affect the type of surgery. The stoutness of a patient may necessitate different tactics from those applicable in a thin individual. The age and any concomitant pathology may also influence operative procedure. The psychology of the patient

likewise will have a bearing on outlining surgery. Some people are so constituted that they would really prefer to die rather than to be left with an artificial anus. With these people one is justified in accepting a little extra risk, in order to leave them with a stoma as nearly resembling the original anus as possible. It is also important to place the stoma so that it may not interfere with the patient's occupation. We recall one completely successful case in which the stoma was so placed that the patient pressed against it continuously at his work of weaving. This became such an annoyance that we were compelled to operate again and change the position of the colostomy, whereupon the patient proceeded to resume his work with pleasure.

Only a surgeon with much experience in assisting at these operations should attempt to perform one himself. During the probationary period he will have undoubtedly discovered a facility for certain types of surgical procedure which will largely influence his choice of operation. We all realize that certain operations are easier for us, even though they may present more actual technical difficulties. It would be very unwise to ignore these considerations in planning operations.

The main purpose of an operation for carcinoma is, of course, complete eradication of the disease by whatever means necessary. To be able to plan such an operation successfully, one must fully appreciate the manner of spread of carcinoma. Cuthbert Dukes and his coworkers at St. Marks Hospital in London have sectioned all the specimens removed from the lower bowel (100) at that institution during the past seven years. These sections have proved conclusively that metastases in the rectum and rectosigmoid first occur in glands at the same level or immediately cephalad to the growth, and then follow the superior hemorrhoidal artery. They have also shown that metastases do not skip over any glands in one chain, but spread evenly and regularly, invading

each gland in turn within that area. They have proved also that the lateral spread from these growths does not occur until the main lymphatic channels are completely blocked, when a collateral lymphatic circulation becomes established and the carcinomatous cells are borne along this current. The paracolic glands lying in the mesenteric border of the pelvic colon were affected in only one case, and that a very late one.

This is a work of tremendous import and bears out fully our own clinical experience with over 1000 cases upon which we have operated. It permits one to discard entirely such radical and useless operations as that popularized by Miles. As can be seen from these findings, when the "Miles" operation is indicated for the removal of a growth, the lateral spread of the disease has already gone so far as to render futile any hope of cure. Since there is no lateral spread of metastasis until the main lymphatics are completely obstructed with growth, there is no necessity of removing large areas of tissue laterally. And since only one case in seven years was encountered at St. Marks Hospital in which paracolic glands were invaded, it seems useless to remove them routinely. If a case be encountered in which there is lateral spread of the growth and involvement of the paracolic glands, then and then only, we feel, is a surgeon justified in performing the "Miles" operation. Therefore one can plan more conservative operations with a lower operative mortality and with the same expectancy of cure.

With this added knowledge, we will now consider the suitable operations for eradication of carcinoma of the rectum and sigmoid. These are simple perineal resection and the combined perineo-abdominal operation, either with an abdominal or a perineal stoma. The two latter may be performed in one or more stages. We have always felt that the one-stage operation is preferable except in the presence of marked intestinal obstruction. We consider that nothing of sufficient impor-

tance is gained by multiple stages to warrant opening the abdomen twice and the second time having to deal with adhesions in their most troublesome state, i.e., when they are filled with small adventitious vessels which ooze throughout the operation. The chief advantages claimed for the multiple stage operation are that it lessens the shock to the patient and permits examination of the liver for metastases. We are not convinced that two or more major operations produce less shock than one, even though the single stage procedure be prolonged. The presence or absence of metastases in the liver does not alter our technique. Therefore, we can see no benefit resulting from a discovery of this condition beforehand.

The abdominal colostomy has always seemed a barbarous method and infinitely damaging to the psychology of the patient. Of course there are occasions when it cannot be avoided, but in most instances it is performed because the surgeon does not realize that a perineal stoma within a year, in people of normal mentality, is fully controllable. In our experience it takes no longer for a patient to learn to control a perineal than an abdominal colostomy. And even if it did take longer, would you not prefer to have some leakage per perineum to feces running down your abdomen? We find that patients do not suffer so much psychic trauma immediately post-operatively if the stoma is placed as near the original site of the anus as possible.

Simple perineal resection is, of course, the operation of choice when possible. In the hands of experts it has a mortality of under 5 per cent. In the light of Cuthbert Duke's work and our own clinical experience it offers just as good a prognosis as a more radical operation, provided the cases are carefully selected. Experience will enable the operator to use this technique upon an increasingly large percentage of cases, since by practice it becomes possible to remove more and more bowel from below.

We have devised a technique, which is reported elsewhere,\* simplifying this operation. We have found that it is unnecessary to make any effort to approximate the bowel to the skin—it is sufficient to excise the bowel at the level of the reformed peritoneal floor. We have also discarded all attempts to close the gaping perineal wound. We merely dress it with gauze soaked in a 10 per cent solution of tannic acid and alcohol. This forms a film which is strong enough to prevent saprophitic infection, but is not dense enough to permit the growth of virulent organisms beneath it. Since we have adopted this technique, the post-operative care of these patients has been greatly simplified. There are no longer prolonged irrigations. Simple lavage to clear away fecal matter is sufficient. There is no infection, and no formation of pus pockets; there is no danger of secondary hemorrhage, the patients are comfortable, afebrile, and are usually out of bed on the seventh to the tenth day. Thus not only is the operative technique simplified, but the operation time is shortened and the period of hospitalization is greatly lessened. We have found that the cosmetic result of

this operation compares favorably with that of any we have seen where attempts at plastic repair were made.

#### SUMMARY

1. Carcinoma of the lower bowel costs 35,000 deaths a year in the United States of America.

2. The main cause is late or faulty diagnosis. This is unforgivable, since 50 per cent of these tumors are within reach of the examining finger; therefore, a digital examination must be done as a routine.

3. The next greatest cause is improper treatment.

4. The abdomino-perineal operation, popularized by Miles, is unnecessary.

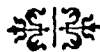
5. Metastatic spread is along the course of the superior haemorrhoidal artery and lateral or retrograde spread occurs only with the establishment of a collateral lymphatic circulation.

6. The perineal stoma is much to be preferred psychologically and functionally.

7. Reference is made to a simplification of the operation of perineal excision of the rectum for carcinoma.

8. The advantages of the use of 10 per cent tannic acid in alcohol in large granulating wounds is explained.

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# ELECTROSURGERY IN PROCTOLOGY

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THE proper status of electrosurgical measures in the practice of proctology has not yet been definitely established. There has been an erroneous impression that electrosurgery has simplified rectal surgery. The availability of a diathermy machine would seem to qualify anyone with the temerity to perform proctologic surgery, although even the good general surgeon is not too well groomed in this field. Furthermore there is an unwarranted idea that any rectal operative procedure, particularly in the case of hemorrhoids, may be done by electrical methods, a practice which deserves particular condemnation. There are certain operative procedures which are undoubtedly better performed by electrosurgical methods, others in which they are contraindicated, and again others in which they are indispensable.

It would seem advisable at this time to attempt properly to evaluate the advantages, disadvantages and indications and contra-indications of electrosurgery in the modern practice of proctology, and to emphasize fundamental electrosurgical effects of the several currents on the anorectal tissues.

## ELECTROSURGICAL CURRENTS

It is not within the scope of this short article to deal with the intricacies and fundamentals of electrophysics. Although quite desirable, such technical knowledge is available elsewhere and is not absolutely necessary to the proper and successful use of the several electrical modalities offered by the modern tube or a spark gap apparatus, whether used for medical or surgical purposes.

It is, however, essential that the operating proctologist be thoroughly familiar with his own particular machine in its various settings and that he have a well defined idea concerning the destructive or electrosurgical effects of the different currents. This applies particularly to their use in and around the anus and rectum where the danger of infection, excessive scarring and sloughing with resultant hemorrhage is not sufficiently appreciated. It should be noted that in the same operative procedure several different tissues whose specific resistance vary to a considerable degree are subjected to the same current intensity. The type of current, the method of its application, and the density or vascularity of the tissues are essentially the factors which determine the depth of destruction, and this to the proctologist is paramount.

Common usage has restricted the term electrosurgery (surgical diathermy, endothermy, electrotomy, etc.) to the surgical application of the high frequency currents of either damped or undamped oscillations. The type of current primarily determines the character of the electrosurgical effects on the various tissues and on this basis they have been classified as: (1) electrodesiccation; (2) electrocoagulation; and (3) electrocutting. The electric cautery, the loop cautery knife (Downes cautery), and galvanism are also currents used for their surgical effects, but since the tissue response is somewhat different, it seems advisable for the sake of clarity to discuss them separately.

Electrocoagulation and cutting may be used to advantage in the same operative procedure; the modern apparatus affords separate terminals for these currents, the

intensity and volume of which are controllable within wide limits, to produce almost any desired electrosurgical effect.

#### ELECTRODESICCATION

The destructive action of the high frequency current from a single terminal was first described by Oudin, and the current is referred to as the Oudin or monoterminal current. It is one of high voltage and low amperage with damped oscillations. In contrast to the current used for coagulation, it produces primarily a dehydrating action on the blood vessels with shrinking and drying of the tissue cells. This is accompanied by a very mild inflammatory response and but little outlying cell degeneration and necrosis. This accounts for the limited superficial and softer scarring resulting from its action, in contrast to the deep, dense and contracting scars produced by coagulation and cautery. Preservation of the normal contractility and resiliency of the anal canal has not been accorded the consideration it deserves. The superficial destructive action of the Oudin current is entirely under control since its action is from without inward in contrast to bipolar or biterminal methods, in which the extent of destruction action is not always predictable within safe limits.

The Oudin current is, therefore, decidedly the preferable one to use in the removal of papillae, polypi, papillomata and other benign tumors of the anal canal. We are convinced that it is the only current to use in hemorrhoidectomy, if electrical methods must be used in this procedure. The author's special technique of using the Oudin current in the removal of hemorrhoids is described elsewhere.

**Hypertrophic Anal Papillae.** These are readily destroyed by exposing them directly after the sphincters have been anesthetized with either novocaine or anucaine. The latter gives more relaxation and better exposure, and it diminishes after-pain. The papillae are desiccated flush with the adjacent mucosa. Accom-

panying deep crypts should be excised and the resulting small wound may be desiccated to control oozing, which is usually slight. If exposure cannot be secured directly, an anoscope may be inserted and the papillae and crypts removed as described.

TABLE I  
ELECTROSURGICAL METHODS (MODIFIED FROM KOVACS)

Form	Technique	Effects
Electro-desiccation.	Active electrode—pen head connected to high voltage terminal (Oudin), in contact with part. Patient may be grounded from a large dispersive diathermic electrode for potentiation of current.	Dehydration and shrinkage followed by superficial sloughing. The preferable current to be used in the anal canal.
Electro-coagulation.	Active, any desired shape electrode connected to one terminal, large dispersive electrode to other terminal. A biterminal needle or clamp connected to indicated terminals of machine.	Coagulation and massive hyalinization of tissue. Deep destruction and deep sloughing. Good hemostasis. Coagulation more or less limited to tissue between needle points or jaws of clamp.
Electro-section, cutting or electrolysis, radio knife etc.	Cutting electrode, needle point or blade connected to one terminal, large dispersive electrode to other terminal.	Rapid dissection and separation of tissue with high intensity of current. Seals capillaries, slight eschar and slough. Lower intensity of current deeper eschar (coagulation). The preferable current for electric snare techniques.
Galvanism (electrolysis).	Active electrodes, long 6-8 inch steel needles insulated 1/2 to 1/4 inch from tip, usually attached to negative pole of galvanic generator. Large dispersive electrode to opposite pole.	Either pole has caustic action (electrochemical). Oxidation on negative pole causes tissue liquefaction, positive a dry necrosis. Used for uncomplicated internal hemorrhoids. A poor and uncertain method which should be discarded.

**Prolapse.** In the so-called first degree prolapse, in which the mucous membrane is erroneously thought to be involved, desiccation has been used with considerable success, particularly by Bensaude of Paris. The cases should be carefully selected. The confusion in the terminology

of prolapse has led in some instances to undesirable and inadequate methods.

The technique consists in drawing out the rectal wall with Allis clamps and making longitudinal lines of desiccation about 1 inch apart. The object is to produce an inflammatory reaction in the submucosa and muscularis with a subsequent deposition of fibrous tissue. After the prolapse has been replaced, the rectum should be packed with gauze surrounding a fairly large sized rubber tube, for forty-eight hours. Subsequent straining at stool is avoided by proper catharsis, tube irrigations and having the patient defecate in the supine position for several weeks. The method is quite satisfactory in children.

Coagulation has been recommended in place of desiccation. However, if the former is used, it is quite essential that the operator know the exact destructive action and depth of the current used. Considerable sloughing with secondary hemorrhage and perforation may occur.

#### ELECTROCOAGULATION

Electrocoagulation employs a current of higher amperage and it results in a rapid and complete destruction of tissue, which is more profound in the center and becomes irregularly less toward the periphery (coagulation necrosis). Recent studies by Keysee and Niede have shown that the necrosis following coagulation is always uneven and varies with the resistance of the different tissues. The resulting slough and tissue destruction is therefore unpredictable.

That the degree and extent of the heat generated in the tissues by high frequency currents cannot be estimated within safe limits, is particularly well emphasized by Caulk and Patton<sup>5</sup> who state: "It was shown that with high frequency currents, which are usually employed, whether the gap or tube machine, definite elevations in temperature were produced in the mediums or tissues away from the point of burning, and the degree of heat varied according to the distance, the current

value, the time of application, and depended not on conduction, but on production in tissue as it came through between the two electrodes at the point of burning."

Histologic studies by the same authors showed the following definite zones of destruction following the application of the high frequency currents:

1. Coagulation necrosis.
2. A zone of fragmentation in which the cells lost their staining qualities and in many instances were broken up. This zone showed copious hemorrhage.
3. A more or less normal zone but in which the cells showed desquamation and evidence of shrinkage.

"It is the deep heat effect that is evidently responsible for many of the late sloughs and erosion of vessels which creates the tendency to secondary hemorrhage and sepsis."

It seems obvious that electrocoagulation in and around the anorectal region, particularly in the anal canal, may be productive of great harm, and with the exception of premalignant, definitely malignant, and granulomatous lesions, its use is unnecessary and undesirable. It should never be used for hemorrhoids of any kind, its many advocates to the contrary notwithstanding. Snare methods in the removal of hemorrhoids with this current deserve particular condemnation. In the best hands, the depth and extent of destruction is not at all predictable within safe limits.

The biterminal use of clamps, electrodes and needles has been devised to overcome these objections. These instruments, however, fail to do so, and there are simpler, safer, and less cumbersome methods of securing the same desired end result.

Electrocoagulation may be used to advantage in the following proctologic conditions. It has, however, a wider range of usefulness in combination with the cutting current which will be discussed subsequently.

*Fistula.* For the destruction of suspiciously premalignant or already malignant excrescences in the openings or tracks of

chronic fistulae, electrocoagulation may prove useful. This applies also to the occasional case of fissure with old chronic hypertrophic edges in which surgery is contraindicated or refused.

Following the incision of fistulae by the cutting current or knife, the common practice of swabbing the wound with pure phenol, with the idea of destroying the remaining tracks or small offshoots, could be advantageously replaced by the more certain and controllable application of the coagulating current. In this instance, the depth of destruction in the tissues external or lateral to the sphincters may be an added advantage. The current should not be applied to the musculature of the anal canal.

The electric cautery may be used for the same purpose; in fact, many proctologists prefer the cautery in fistula incision, particularly in the definitely established tuberculous variety. Where tracks are cleanly and totally excised, there is no indication for further destruction of tissue by any means, electrical or otherwise.

*Condylomata. Anal Warts.* Although electrocoagulation has been used for the destruction of these excrescences, the actual cautery in our experience has been more effective. Thorough eradication is essential for these tumors, and particularly so for those situated in the anal canal or lower rectum, because the secretion and moisture from those untreated or overlooked may lead to prompt recurrence. They are self-inoculable. Luetic condylomata require additional systemic treatment which should be under way before local removal is undertaken. X-ray is at times of great benefit, but should be used with caution.

*Adenoma, "Polypi," Papilloma, Villous Tumor.* Under this heading are included a number of so-called benign tumors, which, however, possess all the anlagen for ultimate malignancy, particularly in adults. On this account, they are of particular interest and importance and their prompt and complete removal is highly

desirable. The vast majority of these tumors lend themselves to removal by electrosurgical methods, but the proper type of cutting current with the electric snare is necessary for their removal. Coagulation is sometimes an additional measure of value in the electric snare technique; it has been referred to as circumvallation, a procedure which produces a ring of coagulation in the mucosa around the snared off stump. This may destroy tumor cells already beyond the confines of the malignant base, and in any event, it interferes further with the circulation of the stump, assuring as much destruction as is possible without actual excision. The mucosa alone should be coagulated. Perforation is possible.

In some cases, the entire tumor may be destroyed by electrocoagulation and allowed to slough off—the so-called *démorsellement* of the French. This may be the method of choice in particular vascular tumors, in those with broad pedicles, or in unfavorable locations where operative interference is refused.

In large or multiple tumors above the peritoneal reflection, it may prove the safer and easier procedure to remove them by laparotomy with excision and resection, or extraperitonealization.

The selection of the most advantageous method may sometimes require experienced surgical judgment. It should also be noted that the technique of the electric snare is not so simple as described.

*Polypoidosis, Multiple Polyposis.* In these conditions, the entire colon is more or less involved, and electrocoagulation is only indicated and useful in the occasional case to destroy tumors in the area of the bowel where anastomosis is contemplated, usually after a graded colectomy.

*Carcinoma.* Electrocoagulation may be used as a justifiable palliative measure in inoperable rectal cancer, and undoubtedly in certain cases it has a systemic effect which is not yet completely understood. We have observed this many times and we

use coagulation in selected cases, combined with x-ray and radon implantation. Our material consists of cases of very

ber of patients over the greatest number of years.

The question of operability depends on

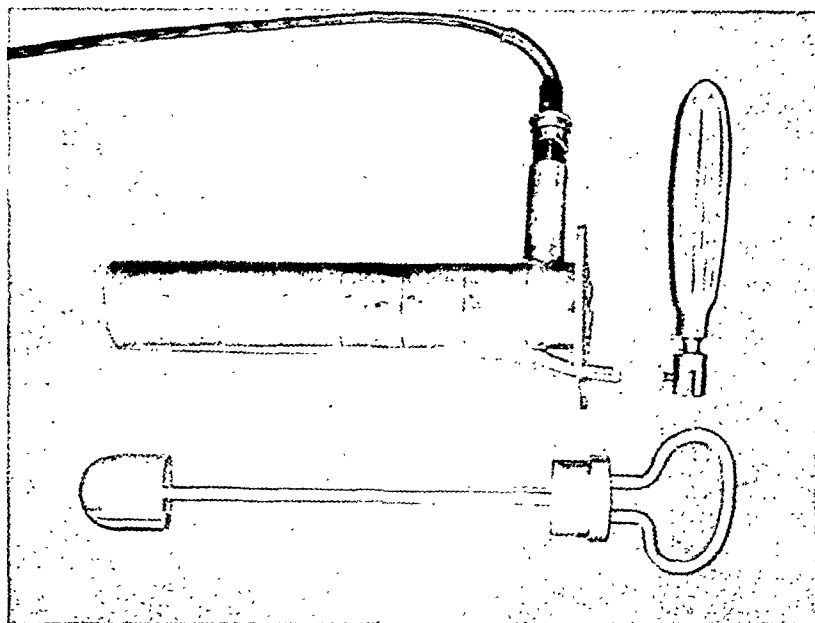


FIG. 1. Author's operating proctoscope with suction tube built in wall of tube and adjustable handle. Useful in the electrosurgical snare techniques.

advanced malignancy, in which our results have not been very encouraging.

One must not wax too enthusiastic about electrocoagulation cancer therapy. We have colostomized many advanced cancer patients who have improved very decidedly. They have lived in comparative comfort for two or three years, and in isolated cases, for five years, with no other treatment.

Binkley and others, emphasizing the value of deep x-ray therapy, have reported similar results.

Finally, a word of warning must be sounded lest many operable cases of rectosigmoidal cancer be sacrificed in the enthusiasm for coagulation. The cases of rectal cancer cured by coagulation are so rare that it certainly should never be offered to a patient with anything but the hope of palliation. It stands on the same questionable plane as x-ray and radium. Granted that these procedures have scarcely no mortality, surgery still offers the only hope of cure, and it unquestionably has cured the greatest num-

too many factors to be discussed here, but it is sometimes a most difficult decision to make, and in questionable cases it should be left to experienced surgeons.

#### FULGURATION

Fulguration is a biterminal method frequently confounded with desiccation and coagulation. It refers to the use of long and hot sparks which are very caustic and produce rapid carbonization. There is no indication for its use in proctology.

#### ELECTROCUTTING

(Endothermy, Electrotomy, Radio-knife, Surgical Diathermy, Etc.)

This consists essentially in an electrical separation of tissue, the exact nature of which has not yet been entirely explained. The wounds produced by the electrosurgical knife differ from the ordinary incised wounds in that the desiccating effect of the electrically produced incisions varies not only in the different tissues of the same individual but also in different

individuals. The current may be of such intensity, or rapidity of frequency, as will produce an extremely rapid separa-

a most gratifying and satisfactory method. It is real cancer prophylaxis.

Dudley Smith of California has devised



FIG. 2. Large perineal granuloma before electrosurgical excision. Male, aged 32.

tion of tissue and so little desiccating effect that it will scarcely control bleeding from the finest capillaries. On the other hand, the current may produce a coagulating effect, leaving a charred surface of several millimeters or more in depth with considerable resultant sloughing (so-called coagulotomy).

The accepted and proper niche for the cutting current in proctologic surgery has not yet been definitely established. It has been used more or less interchangeably with the time-honored scalpel, and while rejected in some quarters, it has been enthusiastically accepted in others. However, there are certain proctologic conditions and phases of surgical procedure in which the cutting current is of unquestioned advantage and these we desire to emphasize.

*Adenoma "Polypi."* The electric snare removal of accessible rectocolonic adenomata and other benign or premalignant tumors is a procedure worthy of greater consideration. Combined with electrocoagulation and the implantation of radon seeds, in selected cases it has proved to be

and uses an electric cautery with suction for the removal of these tumors. In his hands, the method has apparently been quite satisfactory. However, in our experience, we have sometimes found it difficult in certain types of sessilated tumors to determine the exact plane of cautery cutting in relation to the surface of the mucosa. If the plane of cutting is not flush with the surrounding mucous membrane, additional cauterization becomes necessary and the exact depth of destruction is difficult to judge. The cautery, moreover, is not so readily used above the rectal valves and large mucosal folds behind which these tumors are sometimes found. These factors are largely overcome in the proper electric snare techniques.

The author's operating proctoscope with a suction tube built in the wall of the tube to clear the field of smoke (Fig. 3) and the high frequency snare (Fig. 4), are very useful for coagulation, cauterization or electric snare techniques in the rectum and sigmoid.

*Malignancy, Granulomatous Lesions, Dermoids, Etc.* The cutting current combined

with clamp coagulation or direct vessel coagulation has definitely widened the scope of cancer surgery in proctology,

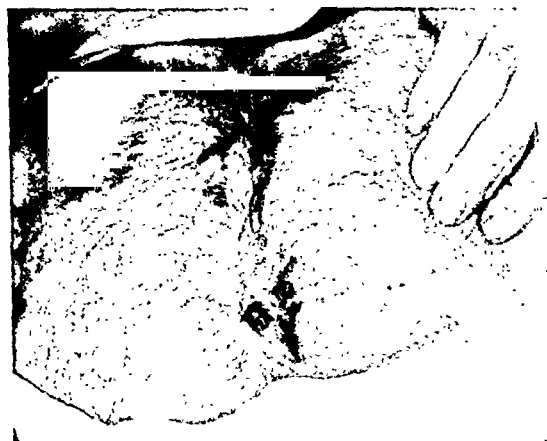


FIG. 3. Same patient shown in Figure 2, after excision of granuloma by electrosurgery.

particularly in the debilitated and elderly patients in whom the diminished hemorrhage is of some importance. The coagulum on extensive wounds seems likewise to lessen the loss of fluids, the absorption of toxic wound products and to decrease post-operative pain. Figures 5 and 6 demonstrate the possibilities and result following the electrosurgical excision of an extensive perineal granuloma in a male, age 32, who was admitted to the New York Cancer Hospital as a hopeless inoperable case. This patient is today actively employed, happy and when re-examined by the author several weeks ago, presented no evidence of his original lesion. It is obvious that the possibilities of electrosurgery were not fully appreciated elsewhere.

We do not, however, consider that the electrosurgical technique has any such decided advantages in the usual combined perineoabdominal or the abdomino-perineal excision of the rectum or sigmoid; certainly not in the abdominal technique. In a simple amputation in debilitated patients, or in those who bleed readily, its hemostatic effect and the time saved in ligature tying and manipulation may be of some advantage; likewise in the excision

of large dermoids, sacral teratomata, angiomas or other excessively vascular tumors.

*Sacro-Coccygeal Sinuses and Cysts.* If the cutting current is used for the excision of these sinuses, the resulting wound should not be sutured. Unless indicated, we likewise believe it unsurgical to coagulate the sacrococcygeal ligament or periosteum. The late sloughing materially delays healing, which is always protracted enough.

*Fistulae.* The cutting current would appear theoretically to offer very decided advantages in the excision or incision of fistulae. In simple straight tracks this is perhaps true, but in deep fistulae where fine dissection is demanded around the rectum or around the anal musculature, we have found the scalpel still the most sensitive and controllable weapon. One can appreciate cutting through diseased tissue with the scalpel, but with the cutting current such a distinction is not so readily made. The actual cautery likewise besmirches the field. It would seem that the advantages of the actual cautery or electrocoagulation could be secured after a careful scalpel dissection.

*Hemorrhoids.* We again mention, in passing, that we are decidedly opposed to the cutting current in any and all hemorrhoids.

*Fissure.* The skin incisions and dissections may be done with the cutting current in fissurectomy with drainage, but great care should be exercised in cutting through the anal musculature. The current separates muscle more readily than any other tissue.

*Stricture.* In selected cases of short tubular, or especially in the diaphragmatic type of stricture, internal proctotomy may offer some degree of palliation. This may be done with the cutting current, but only under direct vision. A single incision may be made through the entire length of the stricture posteriorly; additional lateral incisions are sometimes advisable. These incisions should not be carried through the anal musculature unless the latter is

involved. The cutting current has the advantage of causing less hemorrhage, which may be active in this location.

In external proctotomy, the incision must be carried and extended well posteriorly through the entire anal musculature for adequate drainage. In selected cases, the results are excellent, but the method is only justifiable in strictures of the anal canal proper. A combined internal and external proctotomy usually results in a paradoxical incontinence.

*Biopsy.* The cutting loop offers a very simple and effective technique in securing biopsy specimens from any part of the rectosigmoid accessible to the proctoscope.

*Post-operative Gangrenous Ulceration.* In the very exceptional case of post-operative gangrenous ulceration of the perirectal tissues, the cutting current with heavy coagulation in its wake (coagulotomy) offers decided advantages over the cold scalpel. The actual cautery may likewise be used with equal benefit in this condition.

#### APPARATUS

The market offers several excellent machines for the production of the various electrosurgical currents, usually combined with medical diathermia. For the proctologist the apparatus should offer the following features which we believe are essential to a complete proctologic armamentarium.

1. It should have an outlet for the Oudin current.

2. It should offer good diathermy current for medical diathermy.

3. Separate outlets for coagulation and cutting currents are an advantage, but not a necessity. Separate foot-switches for these currents may at first appear desirable, but the ease with which they can be inadvertently interchanged should be considered.

4. The tube machines producing oscillations of ultra-high frequencies theoretically produce cutting with less and a more even line of desiccation. In facial or other surgery this may be advantageous, but in rectal surgery the spark gap machine fulfils every requirement and is decidedly more rugged.

5. Special electrodes and snares are an essential part of the modern proctologic equipment.

For further detailed specifications on electrosurgical machines the reader is referred to the Council of Physical Therapy of the American Medical Association.

#### CONCLUSION

It may be emphasized that the modern practice of proctology demands a comprehensive knowledge of electrosurgical methods. These offer unquestionable advantages in selected cases and are distinctly contraindicated in others. Their indiscriminate use is to be condemned. They are not a substitute for sound surgical principles and training. A fundamental knowledge tempered with experience in the various phases of anorectal pathology is still a *sine qua non* to successful proctologic practice.





# LOW BACK PAIN

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IN considering the subject of low back pain, the simulation of the symptoms arising from low vertebrocolumnar involvement, and those from abdominovisceral pathologies are readily confused. Pathology involving the prostate, perimetrium, uterus, etc., even remotely the kidney, might be associated with low back pain. A paranephritis, a rectocecal abscess from a chronically inflamed appendix, a duodenal ulcer—any of such visceral pathologies and others could be the hidden cause for spontaneous pain or other symptoms in the region of the lumbar spine, more especially in the upper segments. Visceral conditions offering such a symptom-complex will require the particular consideration for treatment centering upon the organ involved. One should be certain primarily to rule out the possible abdominovisceral involvements as causative factors for low back pain before making the decision that the entity is truly one for orthopedic concern.

That chronic low back pain, when it calls strictly for orthopedic attention, should be considered on the whole as most likely of the arthritides is wrong. Such pathologic systemic entities as osteitis deformans (Paget's disease), osteoarthritis fibrosa cystica (von Recklinghausen's disease), tuberculosis of the spine (Pott's disease), syphilitic arthropathies (tabes), etc., may be first identified by low back pain.

Nevertheless, when definite aids for diagnosis such as capsular thickening, marginal fringing, and fraying of the various skeletal articulations are present, they usually indicate that the pathologic entity of osteoarthritis actually exists per se. When these are found in the spine, the condition is more definitely designated as spondylitis deformans or spondylitis arthritica. However, it is surprising to realize how commonly arthritis occurs without articular involvement elsewhere in the skeleton.

The condition, through its frequency in the lower back, is described as lumbosacral disease or lumbago.

No group of cases presenting low back pain offers a more pathetic picture than do parturient women. During pregnancy they may be given the best of care. The wearing of a support to relieve the load and stretch upon the abdominal and back musculature during the latter months of pregnancy has become almost routine. However, during delivery when there is such a terrific strain placed upon the structures of the lower back and pelvis, so much unusual stretching of the ligaments and muscles, possibly even tearing many of them, no particular after-care is undertaken. An essentially prolonged period of recumbency, beyond the usual ten to fourteen days, is rarely if ever considered. Subsequent proper support to the parts engaged during a difficult delivery are too often overlooked. In the normal delivery this may well be unnecessary, but normal deliveries, in which there has been no maternal slight, are less frequent than is believed.

The obstetrician contends with many abnormalities in the pelvic basin and lower back of the modern woman, many of which must create susceptibility to damage in these parts. When there has been injury or undue effort in delivery, more definite regard should be given to the great need for proper after-care. Rest and support to the severely strained and damaged ligamentous and muscular structures entering into the complicated physiologic process of confinement must be duly regarded. The sacro-iliac synchondroses and the amphiarthroses of the sacrum and lower lumbar vertebrae with their many ligamentous attachments must be allowed to involute.

Numerous joints—at least six—enter into the mechanism of delivery. Following

delivery, no period of time in recumbency shorter than four, or better still, six weeks should be allowed for any woman who has undergone a complicated labor through the normal route. Among women complaining of low back pain before the menopause a large proportion has a history of difficult pregnancies or labors.

Among men the complaint of minor injuries to the back during the active period of life is astounding. Many falls or wrenchings of the back in line of duty or sports have gone unattended and unrecorded. The complications or the manifestations of pathology in the back in these cases are never revealed until brought to light roentgenologically.

Frequently unrecognized causes for low back pain are the various congenital malformations existing in the lower portion of the spine, more especially from the fourth lumbar vertebra down to and including the sacrum. With such anomalies the deep-seated sacrum is common; the accompanying deep-seated fifth lumbar vertebra occasions increased lordosis and causes imbalances which result in muscle strain, spasticity and consequent low back pain. Spina bifida occulta, spondylolisthesis, incomplete sacralization of the transverse processes of the fifth lumbar vertebra, supernumerary and wedged or malformed lumbar and the associated factors, are the common origins of low back pain following strain or minor injury. These conditions, of course, remain unrecognized weaknesses or susceptible areas until strains and minor traumata bring them to the fore. Then they are definitely discovered only through roentgenologic findings. The frequency of anomalies, particularly in the lower spine, should justify our continual suspicion of their presence with the problems which they might develop until they are definitely excluded by the x-ray.

Spondylitis deformans or spondylitis arthritica is mostly confined to the lower back. In fact, it is my opinion that it is most common in this location, with the cervical type second in incidence but following quite a distance behind. The traumatic spine, particularly in the lower

back, is invariably disregarded unless its manifestations are severe in character. The serious types of injury, with immediate and very early cord or nerve root involvement, do not and cannot go unrecognized, but European authorities (Mahler and Schmeiden) are of the opinion that where severe pathology has been ruled out, only 30 per cent of the spinal columnar injuries are seriously regarded and accorded early treatment. In other words, 70 per cent of the lesser back injuries go unattended unless grave complications develop.

The amount of damage which occurs because of neglect of low back injuries is astounding. Nerve root pressure on the lumbo sacral plexus following such damage is far reaching. It does not confine itself to the lower extremities and pelvic viscera, but, sympathetically, it may develop an upward course, frequently evidenced by involvement of the upper extremities, neck and head.

Liberal considered and for simplicity, lumbar spondylitis arthritica should be regarded as lumbago. This symptom-complex is a manifestation of vertebral arthritis of varying intensity in the lumbar articulations, presenting secondarily progressive evidences of inflammation to the nerves, muscles and other soft parts associated with the loins. In other words, if visceral pathology can be ruled out where there is low back pain, and the condition is to be regarded as of an orthopedic nature, the term lumbago will cover the subject generously, allowing for everything that is of direct pathologic significance in the lower back.

The commonest of all forms of low back pain is spondylitis deformans. This type of arthritis occurs in this location as spondylitis osteoarthritica, spondylitis ossificans ligamentosa, and spondylitis ossificans muscularis, separately or in combination. It develops most commonly among corpulent men and women with marked lordosis and rigidity of the erector spinae musculature. They complain of the greatest pain in the small of the back. They suffer from over-stretching of the muscular and

ligamentous structures in the iliolumbar and sacroiliac regions. They complain of a type of backache of long duration, extending progressively over a period of years. Among these cases, calcareous deposits frequently occur in and about the marginal bone, around the bodies and facets, extending in the surrounding vertebral muscles, ligaments and tendons. Inasmuch as these subjects are commonly past middle age, they rapidly approach the senescent type of osteoarthritis.

In all types of low back pain we should not fail to rely upon the help of the roentgenologist for identification of possible pathology in the lumbar, lumbosacral and sacroiliac regions. In many cases, an established painless scoliosis of the lumbar spine is discovered, which the patient strives unwittingly to correct. When there is direct and more or less continuous pain in the lumbar vertebrae, it arises, as a rule, where there has been long illness or suffering in the lower back or loin region. A circumscribed tenderness upon percussion over the lumbar spinous processes is a positive evidence for backache, involving the articulations. Chronic backache precipitating an acute lumbago should present positive roentgenologic findings, such as changed vertebral configurations, dissolution or narrowing of the intervertebral discs, fractures (as impaction of the body or separation of a transverse or spinous process), fissurings, exostoses, bridgings (as in Bechterew's disease), osteoporosis, or other bony abnormalities which bespeak systemic disease (metastasis, osteomalacia, tuberculosis, syphilis, etc.).

Severe pain upon pressure over the spinous processes in the lumbar region and described as ascending toward the head, with no limitation of movement, even with positive roentgenologic findings, should be considered as of neuropathic origin.

In lumbago, the pain in the lower back is usually sudden in onset and of great severity during movements, but there is no pain over the spinous processes. Where there is weakness of the extremities, impairment of the bladder and rectal functions, as well as reflex changes and accompanying

backache, there is damage which involves the cord or nerve roots, and we must consider tabes or cord pressure. Pain in such involvement occurs spontaneously and is not evidenced upon movements of the trunk such as turning in bed. Furthermore, the pain is not limited only to the back, but radiates away from the lesion site.

Chronic spondylitis of the lower vertebrae is confirmed through sharp pain evidenced in this region during maneuvers of sudden loin or waist twisting. A jolt to the shoulders also occasions similar pain. This is accounted for through the presence of muscular rigidity in the painfully affected portion of the vertebral column where there is present an established point of greatest tenderness. It is quite different in the case with fracture of a lumbar vertebra. In such an injury a thoroughly fixed lower back region exists, making it impossible to bend or twist the trunk. All torsal movements are performed with an unchanging stiff back, the motion coming from the hips.

Before closing, a word must be said regarding low back pain due to improper posture of the feet and legs. Pronation symptoms, acute problems arising from varying types of foot trouble, occasioning variation in carriage, etc., will often give rise to this distant disturbance. Although of great disabling significance, it is easily corrected with proper footwear. The correction with proper shoes is surprisingly rapid and complete.

#### CONCLUSION

Orthopedically low back pain is common. Yet it is ordinarily disregarded as a serious entity in spite of very definite pathology in the lumbar and lumbosacral spine, the related soft structures, or both. When considered as lumbago it merits the specific treatment which the clinical and roentgenologic diagnoses establish. And treatment, it is well to know, offers for the most part satisfactory end results. Chronicity is far advanced in most cases when they are finally seen by the orthopedist, but the arrest of the progressive factors, although slow, is definitely established.

# FRACTURES OF THE HIP JOINT\*†

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**F**RACTURE of the neck of the femur, especially of the so-called intracapsular type, is one of the most distressing results of an injury. Occurring mostly in elderly people, often with associated disease of the cardiovascular system, it often results in complications of a serious nature, particularly if the patient is long bedridden. Non-operative methods of treatment have been many and varied, and since the introduction of the classical method of Gordon Buck, some form of extension by adhesive plaster, pulleys and weights has been the method of choice. The Thomas splint, Jones abduction splint, the Hodgen splint and more recently the so-called Russell method have been used extensively. Various special appliances and splints have been developed but are not in general use. In 1904, Whitman advocated the use of abduction with fixation in a plaster spica, and this is now a standard method of treatment. Any complete discussion of the value of these methods is not possible nor concerned with the object of this paper.

The operative treatment of the recent intracapsular fracture has been discussed by surgeons for a number of years. Gwilym G. Davis was among the first to do a nailing operation; later Albee suggested a peg of bone cut from the tibia, Davison a segment of the fibula. Revival of interest in this method of treatment took place when Smith-Petersen published his paper in 1931, advocating the use of the flanged nail which bears his name. Modifications of this nail have been offered and Johansson and others have advocated an extra articular method by which the nail is guided over a wire under x-ray control with the fluoroscope. At a recent meeting of the American

College of Surgeons in Philadelphia, Smith-Petersen stated that he had changed his technique and is now using the extra articular method with the use of the Kirschner wire as a guide.

In the first operation, Smith-Petersen made use of an anterior incision for the exposure of the hip joint (for further details one is referred to his article) and of a flanged nail, which brought about absolute fixation of the fragments in all directions, and displaced the minimum amount of bone. Because of its flanges, the nail is gripped by the cortex of the bone, so that there can be no rotation on account of its shape, and the surface area is much greater than that of the ordinary nail. Friction is proportionately increased on account of the minimum displacement of bone and there is less pressure necrosis surrounding it: consequently the fixation is sustained and complete, not temporary and partial.

The postoperative care is the application of plaster spica, which is split, and application of 5 pounds traction. The cast is bivalved after three weeks, and the patient is gotten out of bed, with cast. This is carried out for a period of four to six weeks, and then the patient should have some support in the form of a plaster spica or leather spica for three to six months depending upon the x-ray studies. The nail is removed at any time after six months if firm union is present. In the twenty-four cases reported, non-union occurred in four, and these were attempted at ten, fifteen, nineteen months, and two and one-half years, respectively.

E. Denegres Martin, in 1933, advised the use of carpenter screws and Hodgen's splint, with six weeks in bed, and has obtained splendid results.

\* From the Service of Dr. George P. Muller, Misericordia Hospital.

† Read before the Philadelphia Academy of Surgery, January 4, 1937.

A. T. Moore, in 1934, has obtained good results by the use of three drill pointed stainless steel pins which are inserted at varying angles, with their points converging to form an equilateral triangular base, and the protruding ends of the drills must be left so that subsequent removal is easy. The position of reduction and of the pins is checked by roentgenogram or the fluoroscope. When the pins are in perfect position, six drill holes are made through the neck and up into the head of the femur. If the patient's general condition permits, he is out of bed the next day. No plaster or other retentive apparatus is necessary. When union is found solid, the pins can be removed at the office under local anesthesia.

John Hoets, in 1935, advised the use of the Smith-Petersen nail and made the following postoperative changes: no apparatus is applied other than a pillow under the knee for comfort, and the patient is permitted to sit up in bed in several days.

The reason for Smith-Petersen nail success is that it prevents rotatory as well as angulatory movements of the fragments and allows immobilization to be continued for six to twelve months without hardship to the patient. In Jones' experience he has noted that one should operate early; operation is not advisable after the first six or eight weeks in high fractures where there is a probability that the blood supply of the head is impaired. He also advises a new exposure of the hip joint, as in one case of the Smith-Petersen type he had a case of flap necrosis. He also uses a guide for the nail, and advises discontinuance of the use of the spatula, for he feels that it causes osteoarthritis of the joint. He states that blind and uncontrolled impaction of the nail is valueless, destroying the cancellous bone, shortening the femoral neck, and may increase the tendency to arthritis by bruising the articular surface. Postoperatively, he does not use plaster spica or other external fixation, and knee movement starts the day after operation. A bedroom slipper with a six-inch piece of wood nailed

on the heel and projecting outwards, is used to prevent external rotation. Weight bearing is started in from four to six weeks depending on the site of fracture. The high type of fracture weight bearing is not started for three months. He has found firm union in four to six months.

F. D. Dickson, in a review of his cases, reaches the following conclusions:

1. Whitman abduction method with modification is the method of choice.

2. In the obese type of patient one should use the Smith-Petersen nail provided there are no contraindications to surgery, as in these cases plaster spica gives poor results.

3. If anteroposterior and lateral Roentgen ray studies indicate unsatisfactory reduction, a Smith-Petersen nail is indicated.

4. If, after three months of conservative treatment, there is a poor result, then Smith-Petersen operation is indicated with a small bone graft taken from the trochanter and placed along the neck of the femur and into the head of the bone, or an Albee bone graft may be performed.

Gaenslen, in his Sir Robert Jones Lecture, stated that the impacted fracture holds the key to solution of the most important problems involved, such as complete apposition and immobilization of fragments, absence of serious damage to vessels, absence of interposed capsule, and resumption of early motion relative in frequency of aseptic necrosis. Therefore, he advises absolute reduction and also spike fixation if necessary to obtain bony union. Aseptic necrosis of the head is the big factor, and is due to lack of circulation in the head fragment; in impacted fracture the circulation is less damaged and fixation is sufficient to allow uninterrupted progress in repair. In fractures that are not impacted, there occurs muscular contraction, even though a double spica is applied, which may very well result in a slight shearing motion of the fracture surfaces one on the other. If internal fixation is used, muscular contraction can result only in intermittent pressure in the direction of

longitudinal axis of the neck, thus not obtaining the shearing factor and therefore capsular fractures treated for the past ten years, prior to September 1935, and found

TABLE I

Type of Apparatus	Age and Sex	Number of Hospital Days	Amount of Shortening	Union	End Result
1. Whitman cast.....	Female 80	150 days	1½ inch	No	Died at home one month later. Was always bed-ridden.
2. Whitman cast.....	Female 70	81 days	None	Yes	Walked 5 months after accident.
3. Bucks extension.....	Female 64	79 days	1 inch	?	Walks with assistance of cane. Refused to be re-rayed.
4. Russell extension.....	Female 63	45 days	None	Yes	Sent home, there re-fractured it.
5. Russell extension.....	Female 75	45 days	None	Yes	Walked in seven months.
6. Whitman cast.....	Male 75	57 days	¾ inch	Yes	Walked in five months
7. Russell and cast.....	Female 78	191 days	1½ inch	None	Bed-ridden
8. Whitman cast.....	Female 88	2 days	None	None	Died two months after accident, bed-ridden
9. Whitman cast.....	Female 76	15 days	None	?	Patient mentally incompetent and therefore kept in bed. Never re-rayed.
10. Russell extension.....	Female 77	156 days	1½ inch	Fibrous	Walks with crutches.
11. Russell extension.....	Male 60	59 days	½ inch	Yes	Walks without crutches in nine months.
12. Russell extension and Whitman cast for 6 months; then Smith-Peterson operation.	Male 37	9 months	1 inch	No	Uses crutches.
13. Russell extension for 9 weeks; then Smith-Peterson nail.	Female 70	12½ weeks	1½ inch	Yes	Uses crutches.
14. Russell extension for 3 weeks; then Smith-Peterson operation.	Male 66	72 days	None	Yes	Walked without support in 6 months.
15. Russell extension—10 days; Smith-Peterson operation.	Female 58	41 days	None	Yes	Walked without support in 3 months.
16. Russell extension—12 days; then Smith-Peterson operation.	Female 61	42 days	None	Yes	Walked without support in 5 months.
17. Russell extension. Refused operation. . .	Male 73	90 days	1 inch	None	Bed-ridden—Convalescent home.
18. Russell extension—9 days; Smith-Peterson operation.	Female 65	45 days	None	Yes	Walked without support in three months.
19. Russell extension—7 days; Smith-Peterson operation.	Female 63	40 days	None	Yes	Walks without crutches in three months.
20. Russell extension—9 days; Smith-Peterson operation.	Male 55	42 days	None	Yes	Walked without cane in 3 months.
21. Russell extension—21 days; Smith-Peterson operation.	Female 64	58 days	None	Yes	Died; x-ray revealed cal-lus in forty days.

stimulating bone formation. Early activity is thus a factor promoting union.

After reviewing the literature, our service decided to review the cases of intra-

eleven in number. They were treated with Bucks extension, Whitman cast, Russell apparatus or a combination of these, with but fair results.

## SUMMARY AND CONCLUSIONS

Our technique was as follows: Immediately upon admission, Russell extension was applied, and cardiac, renal and blood studies made. We tried to operate within the first two weeks (contrary to our early practice). After operation the patient was again placed in Russell extension (this was done in all cases except the first, in which cast was applied as suggested by Smith-Petersen). The patient was kept in bed for three weeks, extension removed, and baking and massage started. Two or three days after the removal of extension, the patient was out of bed and was taught to use crutches. One and one-half months later, he was told to use a cane. Before the cane was discarded, the x-ray film had to show solid union. All patients walked without any support in from three to seven months, except two who are still using crutches.

Although a short series of cases is reported, one cannot but be impressed by the splendid results obtained by nailing and following the Smith-Petersen technique. If this technique is to be followed, the nail should be inserted within the first two weeks, provided the patient's general condition permits.

The open type of operation is advocated because one sees the fracture site, reduction is accomplished, and x-ray guidance is not required. A closed type of reduction, unless combined with proper x-ray guidance and equipment, should not be attempted.

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# FEMORAL HERNIORRHAPHY\*

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**D**URING the past sixty years there have been over one hundred different surgical procedures devised for the cure of femoral hernia and new operations are constantly appearing in the surgical literature. The City of London Truss Society 1921-1927 reported 27 per cent failures from the various types of herniorrhaphy. The Americans reported from 8 to 30 per cent failures and the German and French writers showed from 8 to 36 per cent recurrences.

*Types of Procedures.* It is impossible to go into details concerning the different operations for femoral hernia. There are the low type operations, or those which are performed below the inguinal (Poupart's) ligament, and the high type, or those above the inguinal ligament. Most of the procedures use some form of closure of the femoral ring. Certain of the operations distort the femoral ring. I have heard A. J. Ochsner say in his clinic: "When the circular femoral ring is closed with plain catgut, the percentage of recurrences is small. When the orifice is sutured with chromic catgut the percentage of recurrences is greater. When silk is used, the recurrences are still more numerous. When the femoral ring is distorted by an attempt at closure with silver wire, most of the operations fail."

The author of a recent book on surgery states that the most important thing in the cure of a femoral hernia is the use of a strong suture material. I feel that instead of assuring better results, this method offers a greater percentage of failures. The use of the high operations is more and more advised. It is my opinion that these procedures are more complicated than a simple

low operation and not so applicable in the largest percentage of cases.

*Saccular Theory of Russell.* R. Hamilton Russell of Melbourne, Australia has shown that the femoral sac is an abnormal constituent of the lower limb due to a developmental defect. The femoral sac is present at birth, or grows downward with the leg after birth, and follows the course of the upper branches of the femoral artery as a result of an abnormal attachment of the peritoneum to the sheath of the femoral artery.

*Practical Application.* Clinical evidence and "living pathology" point to the correctness of the saccular theory. This being true, the treatment of femoral hernia would be different than if it were based upon the theory that the peritoneum is pushed through the femoral ring as the result of intra-abdominal pressure in adult life. In 1879, Socin suggested the simple removal of the sac as a radical cure of femoral hernia.

Later Ochsner said that it was not possible to keep any circular orifice in the body open if it were denuded of its natural mucous or serous lining. If the mucous membrane were removed from the mouth or from the anus, the openings could not be kept from closing. Ochsner pointed out the fact that the normal femoral ring is anatomically a circular opening and when associated with a femoral hernia it has a serous lining. He began operating for femoral hernia in 1892 by removing the hernial sac and suturing the skin. He told me that he had never seen a recurrence following a femoral herniorrhaphy when the above method was used, but he had always a certain percentage of recurrences

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following inguinal herniorrhaphy regardless of the method employed. I have never seen a failure with this operation during the time I was on the surgical services of Ochsner and Nelson M. Percy, at the Augustana Hospital in Chicago. I have used the procedure advocated by Ochsner continuously since I was his assistant eighteen years ago and have not seen a recurrence in my own experience. Dr. Percy recently told me that when he began his internship in 1899 at the Augustana Hospital, Dr. Ochsner had been using the method for a number of years. Dr. Percy further said that he had never seen a single recurrence since that time in his own personal experience, which has been a most remarkable one.

In a memoir of Ochsner, Dr. William J. Mayo states: "He was the first to point out that in cases of femoral hernia, if the sac was thoroughly freed, ligated, and dropped back, sutures were unnecessary, because the circular opening would heal to the center if it was not disturbed."

*Adaptability of the Method.* The simple procedure of removal of the sac followed by closure of the skin should be used in those patients who present a femoral ring which has not been distorted. It is not applicable to those who possess a congenitally defective femoral ring or in those who have a ring that has been torn due to traumatism or disfigured from some infection. It cannot be used in an operation where there is a large femoral defect, or for those patients suffering with strangulated femoral hernia.

*Operative Procedure.* The method I have used is as follows: An incision is made over the femoral sac. The sac is dissected free, opened, then explored. The contents are returned to the abdomen. Any adherent piece of omentum is ligated and excised. The sac is carefully examined again to see that it is not adherent to any part of the femoral ring. If further dissection is necessary special care is observed not to injure the femoral ring. The sac is transfixied high up with plain catgut

so that it retracts into the abdominal cavity when it is excised. In cutting off the sac, sufficient peritoneum is left beyond the ligature to prevent it from slipping. Any fat in the ring is removed with a piece of gauze. The skin is closed and a dry sterile dressing applied.

R. Russell has advocated twisting the sac and crushing it high up before applying a ligature. When the peritoneum retracts, it forms a sort of tent inside the femoral ring. I have not used this procedure, but it is a very logical one. I have never applied a pad over the ring when the dressing is put on, as suggested by Russell.

*Surgical Treatment in Strangulated Femoral Hernia.* When a strangulated femoral hernia is present, it is frequently necessary to cut the femoral ring medially. In this incision of the femoral ring, care is taken to avoid an abnormal obturator artery which may pass downward along the medial edge of the femoral ring if the artery arises from the inferior epigastric or the external iliac artery. If the removal of the constriction only is necessary, the sac is excised in the usual manner and the femoral ring is restored to a circular opening by means of a few interrupted chromic sutures. When intestinal resection is indicated laparotomy is necessary.

*Surgical Treatment of a Large Femoral Defect.* When a large femoral defect is present, the method of Edmund Andrews is advocated. If the conjoined tendon is developed, it is sutured to the pubes. In the absence of the conjoined tendon the defect is repaired by sewing a turned-in flap from the external oblique aponeurosis.

*Results of Femoral Herniorrhaphy.* Recurrences will not occur following femoral herniorrhaphy when the circular femoral ring is maintained.

When it is necessary to incise the femoral ring a simple closure of the defect without an attempt to obliterate the ring will offer the best results. A certain percentage of recurrences will follow this type of operation.

If there is a large femoral defect, the operation suggested by Edmund Andrews is the most satisfactory.

#### SUMMARY

The percentage of recurrences following femoral herniorrhaphy is too high.

My experience has borne out the conclusion of my former chief, A. J. Ochsner that the percentage of recurrences following femoral herniorrhaphy is in direct proportion to the thoroughness of the operation.

In any operation for inguinal hernia there will be a certain percentage of recurrences regardless of the type of operation.

A patient anticipating a femoral herniorrhaphy may be assured that he will not have a postoperative recurrence.

#### CONCLUSIONS

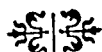
1. In the surgical treatment of a simple femoral hernia all that is necessary is the

complete removal of the sac and the closure of the skin.

2. This type of herniorrhaphy is only adaptable when the circular femoral ring is not distorted and does not apply when there is a large femoral defect, nor is it applicable for the relief of a strangulated femoral hernia.

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# CASE REPORTS

## ULCERATING CARCINOID TUMOR OF MECKEL'S DIVERTICULUM

### CASE REPORT\*

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**T**UMORS of Meckel's diverticulum are still of sufficient rarity to warrant the addition of single new case reports to the medical literature.

Ewing<sup>10</sup> stated that the incidence of Meckel's diverticulum was 2.7 per cent of the population. Balfour<sup>1</sup> reported the occurrence of fifteen examples in 10,600 autopsies (0.14 per cent). Telling<sup>10</sup> reported finding thirty-nine cases in 13,068 consecutive necropsies (2.99 per cent). Nygaard and Walters<sup>26</sup> placed the incidence of Meckel's diverticulum at between 1 and 2 per cent. They added that this anomaly occurred three times more frequently in the male sex.

Tumors of Meckel's diverticulum are very rare. Nygaard and Walters<sup>26</sup> stated that they had found only seventeen cases of malignant tumors of this diverticulum previously reported in the available literature, and added an additional operative case of their own. This was a leiomyosarcoma of a low grade of malignancy. They also mentioned two additional instances: that of Gray and Kernohan<sup>12</sup> which was a true adenocarcinoma, and a case found by Kernohan<sup>18</sup> in which the tumor, diagnosed as a leiomyosarcoma, had been removed by Dr. E. Starr Judd in 1926. Liccione,<sup>20</sup> following his review of the literature, listed six sarcomas, four carcinomas, two medullary carcinomas, three myxomas of indefinite origin, and three tumors of very dubious nature. He added a new operative

case of a spindle cell sarcoma. Copeland<sup>6</sup> found one tumor of a Meckel's diverticulum in 50,000 pathologic specimens at the Johns Hopkins Hospital (0.002 per cent). Of the thirty benign and malignant tumors previously described in the literature, only four (13.33 per cent) were undoubted instances of carcinoid tumors. The case mentioned by Hicks and Kadinsky<sup>16</sup> was said by Stewart and Taylor,<sup>39</sup> who examined some of the original tumor tissue microscopically, to represent only an example of heterotopia of the gastric mucosa. Cooke's<sup>5</sup> reference to an additional case of a carcinoid tumor of Meckel's diverticulum, besides the true instance reported by Stewart and Taylor,<sup>39</sup> has been unverified. The four previously reported carcinoid tumors occurring in Meckel's diverticulum include those described by Stewart and Taylor,<sup>39</sup> one case; Price,<sup>30</sup> one case; and Hertzog and Carlson,<sup>15</sup> two cases. The latter authors found their two instances among 6,138 necropsies (0.03 per cent) conducted at the Mayo Clinic. Chart 1 tabulates the data on these previously described four examples and that of the new case we wish to add.

Lubarsch,<sup>22</sup> in 1888, was the first investigator to differentiate carcinoid tumors from carcinomas of the gastrointestinal tract. Ransom,<sup>31</sup> two years later, substantiated Lubarsch's<sup>22</sup> findings and proposed the use of the differentiative term "carcinomata" to distinguish these atypical tumors from

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## CHART I

## SUMMARY OF DATA OF FIVE CARCINOID TUMORS OCCURRING IN MECKEL'S DIVERTICULA

Author	Year Reported	Patient		Source of Specimen	Silver Reaction	Size of Tumor	Locality Reported from
		Age	Sex				
Stewart and Taylor.....	1926	54	M.	Post-mortem	Yes	"Pea-sized" 1.5 cm. in diameter	Leeds London
Price.....	1935	54	F.	Surgical. Died on second postoperative day of paralytic ileus	No		
Hertzog and Carlson.....	1935	54	M.	Post-mortem	Yes	4 mm. in diameter	Mayo Clinic
Hertzog and Carlson.....	1935	58	M.	Post-mortem	Yes	3 mm. in diameter	Mayo Clinic
Collins, Collins, and Andrews..	1937	56	M.	Surgical. Living and well	Not done	6 mm. in diameter	Hollywood, California

## CHART II

## THEORIES AS TO THE ORIGIN OF CARCINOID TUMORS OF THE GASTROINTESTINAL TRACT

Author	Year	Theory as to Origin
1. Lubarsch.....	1888	Derived from non-designated cells of crypts of Lieberkühn
2. Marchand.....	1907	Derived from embryonic remnants of ductus omphalomes-entericus
3. Trappe.....	1907	Derived from pancreatic tissue displaced during fetal life
4. Toenniessen.....	1909	Derived from embryonic epithelial rests
5. Huebschmann.....	1910	Derived from Schwalbe's or Paneth's granular cells in crypts of Lieberkühn
6. Saltykow.....	1912	Derived from islands of Langerhans in the pancreas
7. Burekhardt.....	1912	Derived from cells similar to basal cells of epidermis
8. Hageman.....	1919	Derived from embryonic heterotopic tissue
9. Danisch.....	1923	Derived from cells of celiac ganglia (sympathetic nervous system)
10. Wolfer.....	1926	Derived usually from Schmidt's cells of crypts of Lieberkühn, but may originate from misplaced groups of Langerhans island cells, or from other chromaffin cells
11. Ehrlich.....	1926	Derived from cells of Auerbach's plexus (sympathetic nervous system)
12. McGlannon and McCleary.....	1927	Derived from chromaffin granular cells in the crypts of Lieberkühn
13. Masson.....	1928	Derived from certain cells at the bases of the crypts of Lieberkühn which wander into periglandular plexi, become filled with argentaffine granules. One solid cell type originates from the Remak cells and another rosette type is derived from the Kulchitsky cells
14. Semroth.....	1928	Derived from faulty differentiation of the entoderm
15. Price.....	1935	Undecided as to whether these are: (1) true carcinomas; (2) basalomas analogous to Krompecher's basal cell tumors of the skin; (3) pancreatic rests; (4) chromaffinomas derived from Kulchitsky cells of the crypts of Lieberkühn and are therefore tumors of the paraganglia
16. Hertzog and Carlson.....	1935	Undecided as to whether these are: (1) entodermal cells arising from intestinal epithelium; (2) ectodermal cells which have migrated to the intestinal epithelium from the chromaffin tissues of the body.

true carcinomas. In 1907, Oberndorfer<sup>27,28</sup> was the first to use the descriptive term "carcinoids." Five years later, Batzdorf<sup>2</sup> and 325 examples of appendiceal carcinoid tumors. Sixty-five per cent of these tumors occurred in females. The finest recent



FIG. 1. Gross appearance of the Meckel's diverticulum showing three of the four smaller diverticula situated at the tip. A puckered scarred area can be seen at the base of the middle secondary diverticulum. The photomicrographs of the tumor were taken through this scarred area.

was able to collect from the medical literature of his day, 114 instances of appendiceal carcinoid tumors and an additional 243 examples from the rest of the gastrointestinal tract. In the latter group of 243 cases, only forty-seven individuals were less than 30 years of age, while the average age was found to be in the early fifties. This finding was in accord with these five cases, comprising the known carcinoid tumors of Meckel's diverticulum.

Simon,<sup>35</sup> in 1916, presented his classical description of carcinoid tumors occurring in the appendix, to which little has been added by subsequent observers. He listed 447 references to the literature of his time

description of carcinoid tumors of the small intestine was presented by Cooke<sup>5</sup> in 1931. He collected 104 cases, twenty-one of which were malignant. Of the malignant tumors, metastases occurred to the regional lymph nodes in eleven instances and in eight additional cases, distant metastases were discovered in the liver. Of the eighty-three benign instances, only six were removed surgically. The sex distribution was nearly equal in seventy-nine patients. The average age in sixty-eight benign tumors was 54.3 years. Greenblatt, Pund, and Chaney<sup>13</sup> found eighteen Meckel's diverticula in 9,000 laparotomies (0.2 per cent). One of these diverticula had a tumor composed of

a benign heterotopia of bile ducts, pancreatic tissue, and duodenal mucosa. Schaetz<sup>34</sup> found that about 45 per cent of the tissue of

Cooke,<sup>5</sup> summarizing the evidence presented up to 1931, concluded that there are a number of unproved theories in regard to

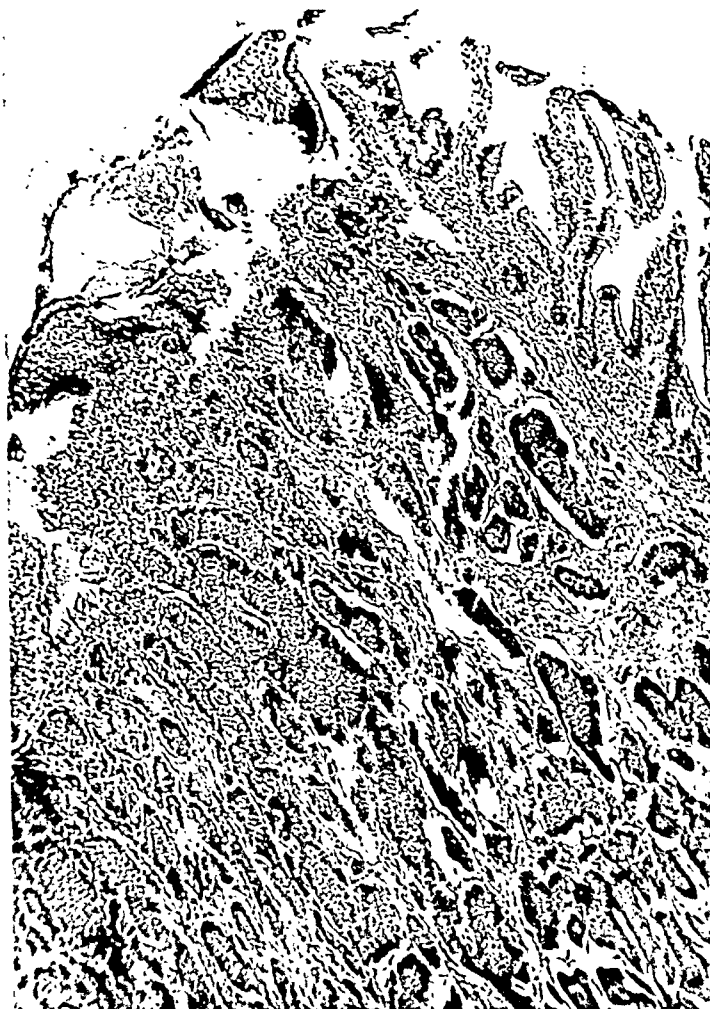


FIG. 2. Photomicrograph of the tumor, showing mucosa of the ileum and the typical carcinoid tumor morphology. ( $\times 26$ .)

diverticula was heterotopic and that 38.5 per cent of these heterotopias were composed of gastric mucosa.

There are numerous theories as to the origin of carcinoid tumors in the gastrointestinal tract. Chart II summarizes the data in this respect. Ewing<sup>10</sup> concluded in regard to these tumors: "Multiple benign embryonal carcinoid tumors of the intestine constitute a peculiar group of tumors of the small intestine first described by Lubarsch. In structure they form three groups, resembling: (a) pancreatic island tissue; (b) heterotopic intestinal mucosa; or (c) Brunner's glands."

the histogenesis of carcinoid tumors and that as yet a final opinion has not been reached.

#### CASE REPORT

A white male, aged 56 years, presented himself for examination at the Hollywood Hospital, having been referred by Dr. Walter C. Alvarez of the Mayo Clinic. His chief complaints were generalized abdominal pain and distention several hours after eating, relieved by belching or by the ingestion of additional food. This complaint had been present for the past fifteen years. During this same period of time, there had been a progressive weight loss of 78 pounds. The patient was a real estate broker by occupation.

His health had been excellent until 1912, when intermittent crampy right lower quadrant abdominal pain made its appearance two hours

developed rather constant marked abdominal distention together with an inability to pass much flatus.



FIG. 3. Photomicrograph of another section of the tumor showing invasion of the muscularis of the Meckel's diverticulum. ( $\times 14$ .)

after meals. There was also pain at night. The ingestion of food or soda gave very prompt relief. At no time was jaundice, vomiting, nor tarry stools noted. An appendectomy was performed elsewhere for "chronic appendicitis," but this operation gave the patient no relief from his chief complaints. After he had suffered for an additional seven years, another surgeon made a diagnosis of a chronic gastric ulcer and performed a local excision of the ulcer in combination with a posterior gastroenterostomy. The patient then enjoyed fair health for about two years. However, during the past fifteen years, his original complaints had returned with such a progressive severity that he had been unable to work for several years. In addition to his chief complaints, he had recently

The important positive findings in the physical examination were as follows: The patient was an emaciated white male, 5 feet 10 inches in height, whose body weight was 101 pounds. He was edentulous. The tonsils revealed chronic hypertrophic tonsillitis. The thorax was of the emphysematous type. Numerous asthmatic râles were heard throughout both lungs. The abdomen was thin walled and moderately distended. Well healed McBurney and upper midline incisions were present. The liver edge and spleen were not palpable. No masses were felt. Moderate diffuse tenderness was elicited about the umbilicus. There was slight muscle guarding in this area. There was no rebound tenderness nor generalized muscle rigidity found. The abdomen was tympanitic through-

out. Auscultation revealed the presence of noisy and tinkling peristalsis, suggestive of an incomplete low grade, lower ileum, bowel

obstruction. Roentgenologic examination of the gastrointestinal tract depicted a slowly emptying posterior gastroenterostomy,

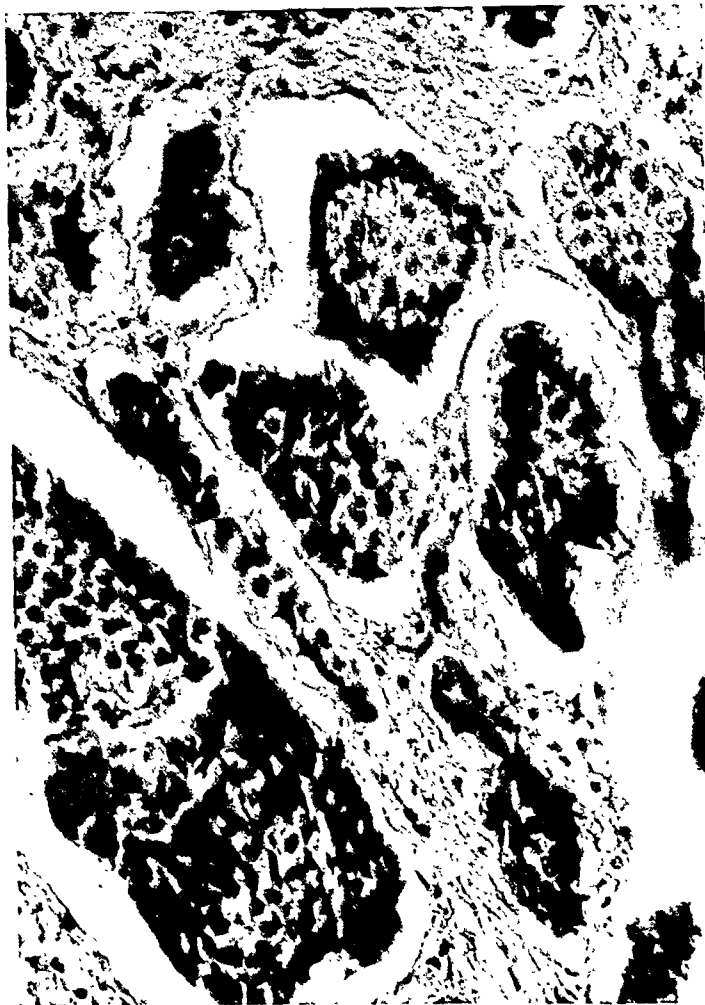


FIG. 4. Photomicrograph showing the cytologic details of the tumor, clearly demonstrating the characteristic appearance of a carcinoid tumor. ( $\times 120$ .)

obstruction. Rectal examination was negative, as was the rest of the physical examination.

The laboratory studies were briefly as follows: The hemoglobin determination by the Sahli method was recorded as 85 per cent. The erythrocytes numbered 4,410,000 per cubic millimeter of blood. The leucocytes were 10,850 per cubic millimeter of blood, while the differential count showed 70 per cent polymorphonuclear neutrophils. The coagulation time was three and one-quarter minutes. The urine examination was negative. Gastric analysis revealed a total acidity of 20 degrees, or 0.730 per cent, and free hydrochloric acid of 8 degrees, or 0.292 per cent. The blood Wassermann and Kahn tests were negative for lues. The lung roentgenogram only revealed increased peri-

believed to be caused by mechanical factors. No other abnormalities were noted.

Our preoperative diagnosis was a malfunctioning posterior gastroenterostomy; possible gastrojejunal ulcer; low grade incomplete lower ileum bowel obstruction caused by postoperative adhesions; old chronic bronchial asthma; marked emaciation.

An exploratory laparotomy was done on September 30, 1936. The former upper abdominal scar was excised. Numerous firm fibrous adhesions were divided around the site of the posterior gastroenterostomy, and also between the anterior abdominal wall and several loops of the terminal ileum which had sharply kinked the latter in several locations. Examination of the posterior gastroenterostomy



stoma under direct vision failed to reveal the presence of either inflammation or a gastrojejunal ulcer. Not being satisfied with these findings, a thorough abdominal exploration was done. This disclosed the presence of a Meckel's diverticulum situated about 80 cm. above the ileocecal valve, and measuring approximately  $6 \times 2 \times 2$  cm. One area at the tip of this diverticulum was scarred and puckered, resembling an old peptic ulcer scar, and there was considerable inflammation present in the adjacent portions of the ileum. The Meckel's diverticulum was removed and the defect in the ileum sutured transversely to the longitudinal axis of the ileum, so as to obviate a subsequent lumen stenosis. The operation was concluded without further incident.

Dr. V. L. Andrews, pathologist of the Hollywood Hospital, described the specimen as follows: "Specimen is a diverticulum: it measures in length 3 cm., and 1.75 cm. in thickness. From this larger diverticulum, there extend four smaller diverticula or pockets. One of these measures 7 mm. in length by 6 mm. in thickness. From one side of this diverticulum there is a definite scarring or puckering as though there might be an ulceration on the side; this measures 6 mm. in diameter and on palpation, before opening, a distinct hardness and thickness may be felt. On opening, the little pockets extending into the smaller diverticula are easily noted. Mucous membrane is present over all, and the hardened firm area lying over the scar noted on the outside is slightly elevated and ulcerated on its inner surface. Microscopic examination of a section through the nodule noted in the wall of the diverticulum shows this to be a tumor growth of small oval cells in which the nucleus makes up the larger part of the cell. The chromatin of the nucleus is broken up and very little cytoplasm is present. These cells occur in large and small groups and infiltrate into the muscularis of the diverticulum. There is no attempt at gland formation and the cells have penetrated to the serosa. This undoubtedly accounts for the scarring of the serous surface. There is no intercellular substance, but between the groups of cells there are small fibrous strands. The picture is quite typically that of a carcinoid or an argentaffine tumor." (Figs. 1-4.)

Aside from a superficial skin separation of a portion of the incision, due to the

patient's poor emaciated condition, which required a secondary closure, the patient made a slow but satisfactory convalescence. His bronchial asthma and an acute upper respiratory infection, contracted after leaving the hospital, have retarded his complete recovery. However, his former abdominal complaints have largely disappeared and he is well satisfied with his immediate postoperative result.

### CONCLUSIONS

The fifth recorded instance of a carcinoid tumor occurring in a Meckel's diverticulum is reported. The patient had signs and symptoms simulating those of a chronic peptic ulcer. Data pertaining to the other four cases previously reported are tabulated. Theories as to the origin of carcinoid tumors of the gastrointestinal tract are summarized. Four photographs reveal the gross and microscopic appearance of this specimen.

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# CAROTID BODY TUMORS

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CAROTID body tumors, long considered as one of the rarer tumors encountered, have been reported in the literature with increasing frequency during the past decade. There are few pathologists and surgeons in active services who have not met with, or heard of one or more of them, yet not many take the time and trouble to record their observations and opinions. This report is offered as a critical review of the literature with the addition of cases of our own. All four of the cases included herein were operated upon by one of us (H. K. S.) in Grace and Receiving Hospitals in Detroit.

Graham,<sup>1</sup> in 1912, was one of the first to review critically the literature of reported cases. In 1929, Bevan and MacCarthy<sup>2</sup> surveyed the literature to date and assembled 134 cases. Rankin and Wellbrock<sup>3</sup> in 1931 reported twelve cases from the Mayo Clinic. In 1933, E. I. and J. M. Green<sup>4</sup> were able to find 196 cases. Since then, reports by Abbott and Stevenson,<sup>5</sup> Chance,<sup>6</sup> Chase<sup>7</sup> Picard and Laduron,<sup>8</sup> Ninger,<sup>9</sup> Bertrand and Sauvage,<sup>10</sup> Cragg<sup>11</sup> and others have added cases. Peterson and Meeker,<sup>12</sup> in reporting eighteen cases operated upon by members of the New York Surgical Society, and including cases seen at the New York Post-Graduate Hospital, state that a cursory review of the literature reveals only 230 cases.

According to Stewart,<sup>13</sup> von Haller in 1743 was the first to mention the carotid body, Newbauer in 1786 the first to describe it; Luschka in 1862 worked out the anatomy and histology. It is said that Reigner in 1880 operated upon the first recognized carotid body tumor and Middle-

ton in 1895 was the first American to do the same.

The carotid body is a paired organ described as being the size of a grain of wheat and as measuring  $5 \times 3 \times 1.5$  mm. Many names have been given to it, such as carotid gland, globus caroticum, glomus caroticum, ganglion intercaroticum, paraganglia caroticum, glandula carotica and intercarotid nodule. Sometimes it is considered to be a ganglion, sometimes a gland of internal secretion.

Its most frequent situation is on the median and deep side of the upper end of the common carotid artery, in close relation with the point of division of the latter vessel into the external and internal branches. It lies not within the bifurcation, but rather on the common carotid artery, so that its form and relation are best displayed by dissection from within outward. It is pinkish-gray in color. Sometimes it consists of two unequal divisions, which are united below. It is intimately connected with the periarterial sympathetic plexus and receives a branch of the glossopharyngeal nerve.

The carotid body is first seen in embryos of 19 mm. (six weeks). The usually accepted theory of development is that the chromaffin cells are derived from the superior cervical ganglion and from the cranial sympathetic ganglion through the ninth and tenth cranial nerves, and that the mesodermal constituents are derived from the third branchial arch. A second theory is that it is derived in entirety from the third or fourth branchial cleft. The third theory is that it is derived from the "perithelium" of the carotid artery. It

reaches full development between twenty and thirty years and remains stationary for a period, after which the interlobular vessels thicken and sclerosis and atrophy of the organ result.

Microscopically, the carotid body is composed of a framework of highly vascular connective tissue, which supports spheroidal groups of epithelial cells with poorly defined boundaries, closely associated with tufts of capillaries. These capillaries are thin walled, large in diameter, and sinusoidal in character.

Stewart<sup>13</sup> made a number of original and quite interesting observations in this field. He describes two types of cells which he designates as "A" and "B." "A" cells are large and polyhedral, rich in cytoplasm which stains poorly and is finely granular, and form somewhat of a syncytium. The nuclei are large, round or oval, somewhat eccentric, rich in chromatin, and show a nuclear membrane. Other cells closely resembling them are found, which are slightly larger, with less granular cytoplasm, and containing small vacuoles. The "B" cells he believes to be endothelial; these are found around the periphery of the lobules. They are small or medium sized, have little cytoplasm, and deep staining nuclei which are oval or spindle-shaped. He observed, occasionally, a few scattered eosinophiles.

The physiology of the carotid body has not been satisfactorily worked out. For many years, it was generally accepted as part of the chromaffin system. This theory has been strengthened by the recent report of Cragg,<sup>11</sup> in which he described a case of carotid body tumor which was accompanied by tumors of the Zuckerkandl bodies. De Castro<sup>14</sup> produced evidence that the carotid body does not contain epinephrine; he suggested a relationship to the carotid sinus, an opinion which Heymans<sup>15</sup> supports. Frugoni (quoted by Nix and D'Aunoy<sup>16</sup>) does not believe that there is any internal secretion. Bilateral extirpation has been done without any untoward symptoms. The case reported by Nix and

D'Aunoy had hypertension, which decreased after removal; the authors gave no opinion as to the cause, but stated that they did not believe the drop in blood pressure was occasioned by the removal. In one of Stewart's<sup>13</sup> cases syncopal attacks occurred. Needles<sup>17</sup> also observed a case in which there were syncopal attacks.

Infections of the carotid body have not been described. The occasional eosinophilia described in the normal gland by Stewart<sup>13</sup> may be infectious in origin.

The only pathologic change described is that of tumor formation. Sullivan and Fraser<sup>18</sup> classify the tumors into two groups. The first group, by far the most common, resembles closely the normal gland structure. The second group includes those described by various authors as sarcoma, sarcoma-like, pseudosarcoma, endothelioma and perithelioma, the multiplicity of the names suggesting to Sullivan and Fraser the uncertainty of origin. They believe that some of the histologic pictures represent different stages of cell maturation in another line of differentiation of the neural crest epithelium from which the sympathetic nervous system is derived; e.g., neuroblasts giving rise to neuroblastomas or capsule cells, or perhaps Schwann sheath cells giving rise to neuroblastoma-like tumors with true ganglia cells or axis cylinders. They conclude that the tumors are neuroblastomas, or at least varieties of neuromas, and not tumors of fibroblastic or endothelial origin; hence the names of ganglioneuroma, paraganglioma, chromaffinoma, neuroblastoma.

Ewing<sup>19</sup> considers carotid body tumors to be a variety of perithelioma, which consideration he bases on their morphology. It must be remembered also that where there is fascia, connective tissue tumors may arise, and that where there are blood vessels, vascular tumors may arise.

The nosology of carotid body tumors will remain in doubt until the embryology and physiology are better understood than at present.

There has been only one instance of multiple cases of carotid body tumors in a family. Chase<sup>7</sup> reported two cases in sisters; one was bilateral and occurred at the age of twenty seven; the other was unilateral and occurred at the age of twenty eight.

The general clinical features have been worked out in detail by Bevan and MacCarthy.<sup>2</sup> They found that 70 per cent of the cases occurred in the forty to sixty year age group, with an average of forty-two years, although cases have been described in the very young and the aged. The sexes are affected about equally. The important finding is a tumor. In but two cases did they find metastases to neighboring lymphatic nodes reported. Secondary generalized effects, such as anemia or cachexia, do not exist unless there are metastases. In two cases syncopal attacks have occurred, which suggests involvement of the carotid sinus.

Carotid body tumors, in spite of their rarity, are extremely important because they arise in the neck, and present themselves in the same general area as do so many other tumors and swellings. However, carotid body tumors usually can be diagnosed before operation, especially where the external carotid artery is seen or felt over the outer surface. Another important physical finding and one which is almost pathognomonic of carotid body tumors, is radial mobility and longitudinal fixation. This is because of the intimate association with the carotid arteries.

Greene and Greene<sup>4</sup> suggest that attempted aspiration, injection of opaque media and punch biopsy may be of great aid in differentiating carotid body tumors from branchiogenic cysts. We agree with the possibility, but there is ever a source of danger in the close proximity of the carotid arteries, the position of which cannot be determined without dissection.

There are no other available laboratory or x-ray methods which directly aid in diagnosing carotid body tumors. From the standpoint of ruling out other conditions,

general diagnostic procedures, such as a tuberculin test, a complete blood count, serologic test for syphilis and flat plate x-ray should be done routinely.

There is considerable discrepancy in the literature concerning the treatment. Bevan and MacCarthy<sup>2</sup> insist that x-ray therapy should be used if the diagnosis is made. They are supported in their contention by the morbidity and mortality which follow ligations of the common carotid arteries. However, few cures have been reported by x-ray. Stewart<sup>13</sup> thinks that radium is of little value and quotes Birman, who gives the same opinion. Nix and D'Aunoy<sup>16</sup> believe that surgery is the method of choice and that it should be supplemented by x-ray or radium. Joyce and Diack<sup>20</sup> favor ligation of the common carotid artery. In our own experience, surgery alone has proven quite satisfactory.

#### CASE REPORTS

CASE 1. H. W., a white boy, age 15, entered the Detroit Receiving Hospital on July 5, 1921, with the complaint of a tumor beneath the angle of the right jaw. The mass was first noticed two months before. At that time, he was unable to open his mouth widely and he had some pain in the jaw region when such an attempt was made. He had had no sore throat. At the time of onset, there was some watery discharge from the right ear. The boy and his mother based the condition on a blow from a baseball bat upon the left occipital region eight months before. During the two months before admission, he had had the tumor incised and drained twice under the supposition that acute cervical adenitis or tuberculosis was present. Neither time was tissue taken for microscopic pathologic examination. Subsequently the tumor increased in size.

On examination, a mass measuring approximately  $5 \times 4 \times 3$  cm. was present below the angle of the right jaw. There was a scar of previous operation along the anterior border of the upper part of the right sternocleidomastoid muscle. There was a point of tenderness just below the ear. The cervical lymphatic nodes were palpable on the right side below the tumor, and still larger glands were felt

beneath the other angle of the jaw. The patient could open his mouth about one-half the normal distance freely and without pain, further opening seemed to be impossible. Other points

in the examination revealed normal eye grounds and pupils. The protruded tongue deviated to the left. There were no other neurologic abnormalities. Roentgen examina-



FIG. 1. Case 11. Transsection of the tumor in the gross at different levels and all specimens trans-fixed on a long needle. The carotid body tumor has surrounded and compressed the common carotid artery and its branches.



FIG. 2. Case 11. Photomicrograph, showing the large blood spaces and the parenchymal cells between.

tion failed to reveal fracture of the skull or any signs of ankylosis of the right jaw.

On July 8, 1921, a third operation was performed. This consisted in removal of a tumor from the region of the bifurcation of the right carotid and a bloc excision of the upper right lymphatic glands off the carotid packet. A portion of the sternocleidomastoid muscle and the lower tip of the parotid gland were included in the resection.

*Pathologic Report.* This report was made by Dr. Plinn F. Morse, who stated the tumor to be a perithelioma of the carotid body with infiltration of the lymph nodes. The patient was discharged from the hospital eight days after the operation.

There are no available photographs, photomicrographs or follow-up of the case.

CASE 11. J. E., age 52, was admitted to the Detroit Receiving Hospital on August 21, 1933, complaining of a swelling below the angle of the right mandible, of twenty years' duration. The swelling had slowly and progressively increased in size. Of late, it had become tender and was painful during cold weather.

There was a large mass in the upper portion of the right side of the neck. It could be moved from side to side, but not up and down.

It appeared to be attached to the sternocleidomastoid muscle and somewhat in turn to the overlying skin. No pulsation was made



FIG. 3. Case II. Showing the oblique skin plane incision used in all but Case III, in which an incision was made parallel to the anterior border of the sternocleidomastoid muscle.

out. It was slightly tender. There were no pupillary changes.

On August 22, 1933, this tumor was removed along with adjacent infiltrated tissues. The growth was found to be at the bifurcation of the carotid and completely surrounding the three vessels. The right common carotid artery with its external and internal branches, the internal jugular vein, the vagus nerve, the hypoglossal nerve and its descending branch, and a portion of the sternocleidomastoid muscle were all infiltrated and had either to be divided or resected in order to remove the tumor. The recurrent laryngeal and superior sympathetic nerves were divided. The arteries surrounded by and distal to the tumor were markedly diminished in size. This was probably due to compression of the growing infiltrating mass. Except for hoarseness, he made an uneventful recovery. Subsequent examinations showed that the seventh, ninth, tenth, eleventh, twelfth and the cervical sympathetic nerves had been interfered with. No brain involvement occurred.

He has been seen from time to time after leaving the hospital. (Fig. 3.) Forty months

after operation, there had been neither general nor local recurrence. The nerve involvements stated above remained about the same, except

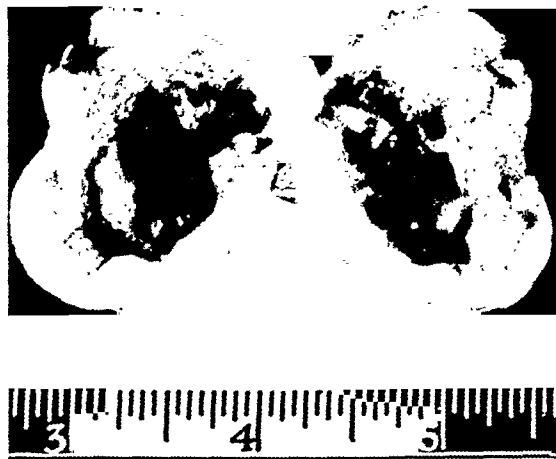


FIG. 4. Case III. Photograph of gross specimen, bisected.

that the facial nerve injury proved to be a temporary one. The hoarseness, enophthalmus, ptosis of the eyelid and contraction of the left pupil were much less noticeable. In fact, this patient states that he can see better with the involved eye than he can with the opposite one.

*Pathologic Report.* Dr. O. A. Brines made the following report: "In the gross, the specimen is an irregular oval shaped mass, weighing 60 Gm. and measuring 5.5 cm. in maximum diameter. (Fig. 1.) The mass contains a portion of the external jugular vein at the anastomosis of one of its tributaries. On section, the tissue is soft and friable and deep yellowish pink in color in the fresh state.

"Microscopically, the sections represent new growth tissue and the various areas show practically no variation in cell morphology. (Fig. 2.) The neoplastic cells are fairly large with light staining acidophilic cytoplasm. The nuclei are deep staining and there is a considerable variation in the size and staining intensity of the nuclear material. These cells are arranged in small masses separated by large capillaries. In some areas there is abundant blood pigmentation. This tissue possesses very little stroma and there is only a slight amount of necrosis. One section contains a large artery. Diagnosis—Carotid body tumor."

CASE III. The subject was a white female, age 36, who was admitted to Grace Hospital August 2, 1934, referred by Dr. J. P. Buchanan. She first noticed a swelling below the angle of

the jaw several years before, following the extraction of several infected teeth. It decreased in size under iodine therapy but remained

temperature of 100 degrees for three days. Twenty-nine months after the operation, she was perfectly well. No hemiplegia, even



FIG. 5. Case III. Low power. Note the alveolar architecture and the fine connective tissue trabeculation.

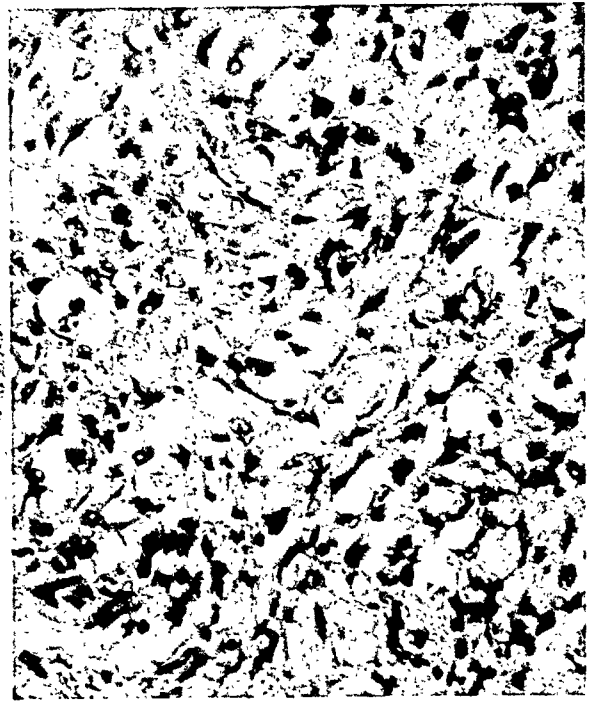


FIG. 6. Case III. High power. Note the sinusoidal arrangement and the vesiculation of the tumor cells. Note also the variation of the size of the nuclei.

present for several years. For the previous three years, it had slowly increased in size and for several months before operation, she had a little pain and discomfort. There was some limitation of motion of the head due to the size of the swelling.

Examination showed a firm, rounded swelling below the angle of the jaw, and anterior to the sternocleidomastoid muscle. It extended under this muscle and displaced it forward. It was not tender and the skin was freely movable over the mass. There was a pulsation and bruit present. The surface of the swelling was smooth and elastic. No fluctuation could be elicited. The remainder of the physical examination was negative.

The blood Wasserman was negative. The blood and urine were normal. Von Pirquet tuberculin test a week before the operation was negative. The blood pressure had never been observed to be abnormal and at the time of operation was 118/72.

On August 2, 1934, the tumor was removed surgically under combined local and general anesthesia. The common carotid artery and both of its branches were ligated.

Postoperatively, there was a slight temporary facial paralysis, a temporary tachycardia and a

transitory, such as is common with carotid artery ligations, developed.

*Pathologic Report* "The tumor removed at operation weighs 28 Gm., is firm in consistency and is encapsulated. On gross section it cuts easily, and yields no tissue when the surface is scraped with a knife. It is yellow-white about the periphery and is red and highly vascularized in the center. (Fig. 4.)

"Microscopically it is composed of a framework of fibrous tissue which is hyalinized in some areas. This varies in amount throughout the tumor, in some places being almost absent and in others quite abundant. In those areas where it is most abundant, it contains many capillaries, which in some areas are almost sinusoidal in character. The tumor cells proper are arranged in poorly formed alveoli, which in some areas are separated by connective tissue trabeculae and in other areas are in almost solid masses with fibrillar stroma. The cells are perithelial appearing, have poorly defined cell borders. The cytoplasm is pale, slightly granular in some cells and vacuolated in others. The nuclei stain lightly, have a reticular framework and distinct borders.



Both cells and nuclei vary considerably in size and in staining. There are a number of small, round and plasma cells throughout the tumor,

He had noticed it first as a rather hard mass, about 2 cm. in diameter four years before. This grew rapidly for two years, at which time

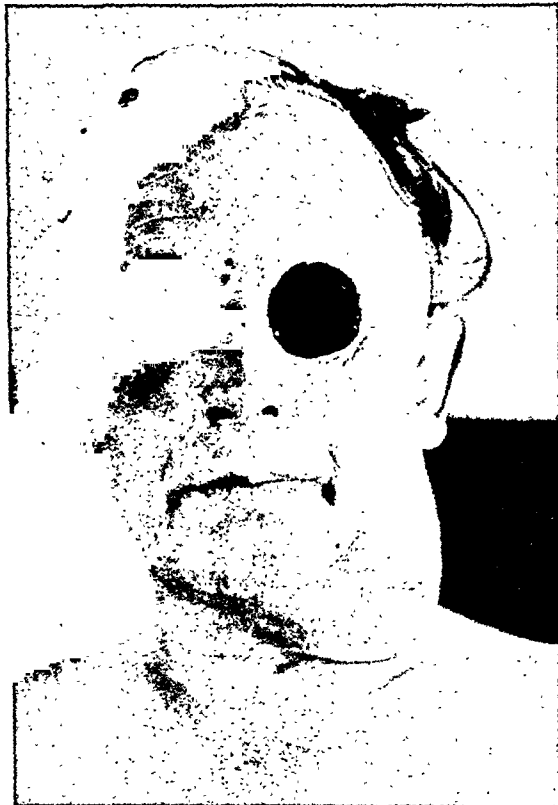


FIG. 7. Case iv. Showing a large carotid body tumor on the left side of neck.

some in localized areas and others scattered diffusely. (Figs. 5 and 6.)

"Diagnosis: Carotid body tumor."

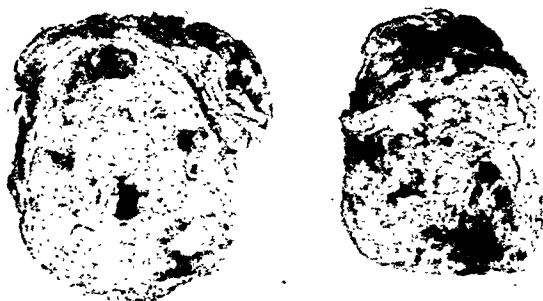


FIG. 8. Case iv. Carotid body tumor, bisected.

CASE IV. E. W., age 40, entered the Detroit Receiving Hospital on September 24, 1935, with the complaint of a large mass in the upper part of the left side of the neck.



FIG. 9. Case iv. High power. Photomicrograph showing alveolar architecture.

it reached the present size. It had never caused any symptoms.

There was a large, rather soft, egg-shaped tumor located on the left side of the neck, below and behind the left ear. It was about 8 cm. in diameter and the sternocleidomastoid muscle passed over the central area. The tumor was not tender, not adherent to the skin, and could be moved from side to side, but not in the vertical direction. (Fig. 7.) While there was no expansile pulsation of the tumor, a pulsation could be seen over its surface, suggestive of an artery. The laboratory analysis was essentially negative except for strongly positive serologic findings.

On September 27, 1935, the tumor was removed. The external carotid artery was flattened out over its surface. Along with the encapsulated tumor, the common carotid artery with its branches, the internal jugular vein, the vagus nerve and the descending branch of the hypoglossal nerve were resected. Except for injury to the hypoglossal nerve, recovery was uneventful. There was no recurrence a year and a half after operation.

*Pathologic Report.* Dr. O. A. Brines reported the pathology as follows: "The gross specimen is a somewhat irregular, oval shaped tumor which is apparently encapsulated and measures 7 cm. in length, 5.5 cm. in width and 4.5 cm. in thickness. There is considerable fascia attached to the capsule. The external jugular

vein runs through one edge of the mass. The specimen weighs 90 Gm. (Fig. 8.) On section the color is somewhat mottled with dark brown areas on a pink-gray background. In the center there is an area of liquefaction necrosis.

"Microscopically, the sections represent a solid neoplasm composed of fairly large cells with pale staining cytoplasm, which is slightly basophilic. These cells possess oval shaped nuclei, which have a fairly high chromatin content and are quite uniform in size and staining intensity. These cells are arranged in small groups and the individual cells in these groups are not well defined. The tissue is exceedingly well vascularized and the cell clusters are invariably separated from each other by capillaries, which are usually widely dilated. Due to this vascular distribution, all of the cells are in close proximity to capillaries. There is a thick capsule and wide fibrous trabeculae. The tumor contains large thick-walled blood vessels, most of which are veins. In some areas, there is a generous deposit of blood pigment, suggesting a previous hemorrhage. In some areas, there is considerable fibrosis and hyaline replacement of the tumor parenchyma. In the fibrous tissue, there is a perivascular infiltration of lymphocytes. (Fig. 9.)

"Diagnosis: Carotid body tumor."

#### SUMMARY

1. Four cases of carotid body tumor subjected to surgical removal are reported.

2. Three were in men and one in a woman and their ages were respectively 15, 52, 36 and 40 years.

3. The tumors were of two months', twenty years', three years' and four years' duration. That they may exist for years without complications is illustrated by the second case. This brings up the question of radiation treatment.

4. A correct preoperative diagnosis was made in three cases and during operation in the fourth.

5. Two tumors were encapsulated and two had infiltrated the surrounding tissues.

6. The carotids were ligated once and resected twice. The tumor was removed once without injury to the vessels.

7. The facial nerve was temporarily injured twice. The right vagus nerve was resected three times. The spinal accessory

was injured twice, the hypoglossal twice and the cervical sympathetic nerve once.

8. No case at any time had hemiplegia.

9. None received preoperative, and but one postoperative x-ray therapy.

10. There were no deaths and no recurrences respectively forty, twenty-nine, and fifteen months after operation. One case could not be traced.

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# CHROMARGENTAFFINE TUMORS OF THE APPENDIX

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IN a series of 4,224 appendices examined at our surgical pathologic laboratory in the last four years, we have diag-



FIG. 1. Case I. Nest of cells with granular cytoplasm, small spheroidal uniform nuclei.

nosed five cases of carcinoid which we report with special reference to their clinical behavior and ultimate course.

**CASE I.** (Service of Dr. M. Fellman.) Mrs. M. H., 45, white, entered the hospital August 1932, because of profuse vaginal bleeding of four days' duration. Her past history included the usual childhood diseases. She had three children alive and well, and had had her menopause in July 1931. Vaginal bleeding began in January 1932, lasted two days, and had been intermittent since then. Dull backache had been present for three years, but recently had been more noticeable. Her appetite was good, and there was no loss of weight.

Physical examination was essentially negative. Pelvic examination showed the cervix and introitus to be normal and a uterine polyp protruded from the cervical canal. The uterus was free and movable, but nodular.

**Laboratory Findings.** There was a slight secondary anemia. Otherwise the findings were negative.

**Operation.** On August 10, 1932, a supravaginal hysterectomy and appendectomy were performed. The course was uneventful with ultimate complete recovery.

**Gross Pathology.** The uterus showed intramural and subserous fibromata and a uterine polyp. The appendix measured 6 cm. in length and varied from 0.5 to 1.3 cm. in diameter at its tip. The serosa was smooth and shining. On section, the distal fifth of the lumen was obliterated by a firm, resilient, bright yellow nodular mass, measuring 0.9 cm. in its largest diameter.

**Microscopic Description.** Sections showed hypertrophic anastomosing strands of partially hyalinized stroma supporting nests and clusters of cells with granular cytoplasm and indefinite pericellular membranes. The nuclei were round or spheroidal, rather uniform and heavily dotted with chromatin material. The muscularis and serosa were invaded and infiltrated, but always separated from the tumor by narrow or broad bands of hyalinized stroma. Sections stained by silver impregnation showed an affinity of the cytoplasm granules for silver.

**Diagnosis.** Argentaffine tumor of the appendix.

**Comment.** The outstanding feature of this case is that the tumor was an incidental finding. The tumor was single and the patient is well to date.

**CASE II.** (Service of Dr. E. Burke.) Mrs. H. S., 44, white, was admitted to the hospital in September 1933, with a diagnosis of umbilical and right inguinal hernia. Past history included the usual childhood diseases, and the delivery of two children, now alive and well. The umbilical hernia appeared following the delivery of a healthy baby twenty years ago; three months previous to admission, the patient

noticed an enlargement in the right inguinal region. Laboratory findings were within normal limits.

*Comment.* This case is like that preceding. The patient is well to date.

CASE III. (Service of Dr. M. Fellman.)

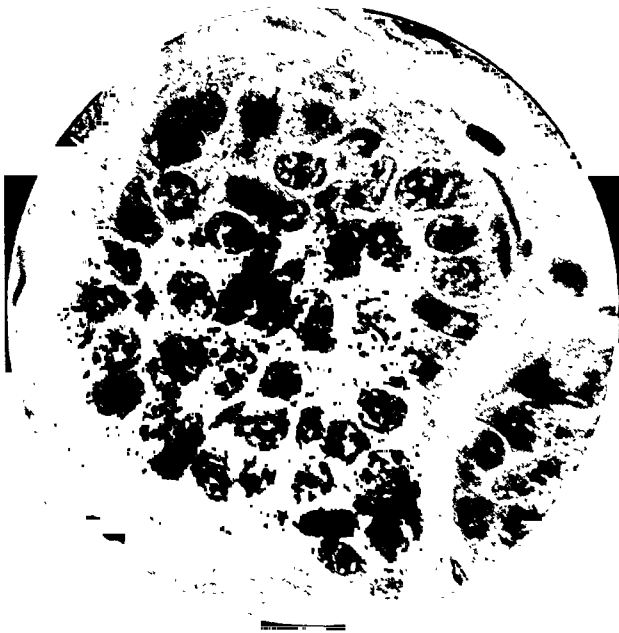


FIG. 2. Case II. Oil immersion magnification. The peripheral cuboidal or columnar cells have eccentrically placed, spheroidal or elongated nuclei. The cytoplasm is profuse and finely granular.

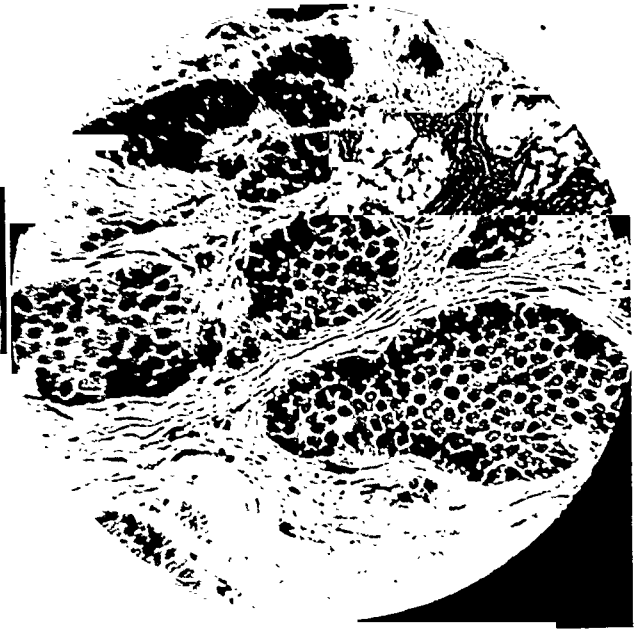


FIG. 3. Case II. Low magnification.

*Operation.* On September 8, 1933, repair of the right inguinal and umbilical hernias and a prophylactic appendectomy were performed.

*Gross Pathology.* The specimen received at the laboratory was an appendix measuring 6 cm. in length and 0.5 cm. in diameter. The serosa was smooth. On section, the wall was thickened and the lumen near the tip was obliterated by a yellowish mass 0.4 cm. in largest diameter.

*Microscopic Description.* Sections of the appendix showed a diffuse hyperplasia of the stroma, which was occasionally hyalinized and in which were cords or clusters of cells. These had uniform round nuclei devoid of any mitotic figures. The cytoplasm was finely granular and slightly neutrophilic. At the periphery the cells assumed a low columnar or cuboidal shape with round or elongated eccentrically placed nuclei. The muscularis and serosa were not involved and were sharply limited from the tumor by a thick partially hyalinized stroma. Silver impregnation shows the granules of the cytoplasm to be stained by silver.

*Diagnosis.* Argentaffine tumor of the appendix.

Miss T. D., 21, white, was admitted to the hospital April 16, 1934, because of pain in the right lower quadrant of forty-eight hours' duration. Her past history included a tonsillectomy at the age of 6 and rheumatism as a child. The present history began two days previous to admission with sudden onset of "knife-like" pains in the epigastric region, which one-half hour later, shifted to the right lower quadrant. The patient had some nausea but no vomiting.

*Physical Examination.* The patient appeared toxic. The lungs were negative. There was marked enlargement of the heart to the left; the maximal impulse was at the fifth interspace, 14 cm. left of the midline. There was a presystolic thrill over the whole apex; a rough systolic and crescendoing diastolic were noted in the same areas. The pulmonary sounds were louder than the aortic; the sounds were of fair quality. The right side of the abdomen was firm and rigid. Deep pressure at the right lower quadrant produced marked pain.

*Laboratory Findings.* There was a leucocytosis, with 80 per cent polymorphonuclear leucocytes. Otherwise the findings were negative.

*Operation.* On April 16, 1934 an appendectomy was performed under spinal anesthesia.

The course was uneventful with ultimate complete recovery.

*Gross Pathology.* The appendix measured

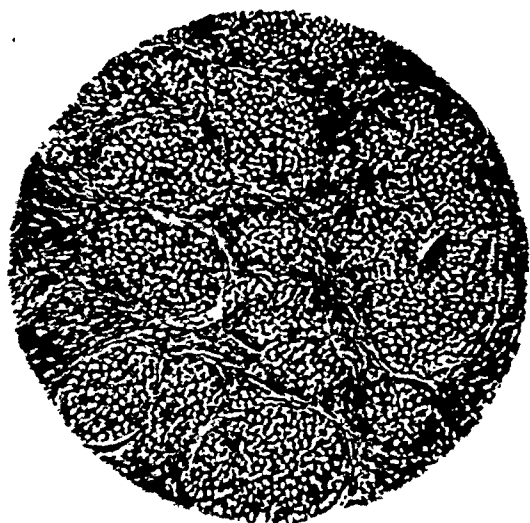


FIG. 4. Case III. Nest of cells separated by strands of partially hyalinized stroma. The nuclei are uniform and moderately dotted with chromatin.

9 cm. in length and varied in diameter from 0.7 to 1.3 cm. The serosa was covered with a fibropurulent exudate. On section, underneath the mucosa there was a bright yellow single nodular mass 0.8 cm. in diameter. The lumen was patent but narrowed.

*Microscopic Description.* Within the submucosa were groups and strands of cells with uniform round nuclei moderately dotted with chromatin but devoid of mitosis. The cytoplasm was quite granular and the cellular membranes indistinct. The crescent-like mucosa was atrophic and the lumen narrow. The stroma was partially hyalinized and more abundant at the periphery of the tumor. The muscularis was atrophic and infiltrated. The serosa was devoid of neoplastic involvement. The entire wall was diffusely spotted with polymorphonuclear leucocytes, with marked edema and congestion. Silver impregnation showed the granules of the cytoplasm to be stained by silver.

*Diagnosis.* Acute suppurative appendicitis. Argentaffine tumor of the appendix.

*Comment.* This case presented a typical history of appendicitis. The patient is well to date. The case was complicated by a rheumatic heart.

CASE IV. (Service of Dr. M. Fellman.) Miss A. L., 19, white, was admitted to the hospital February 10, 1935 because of pain in

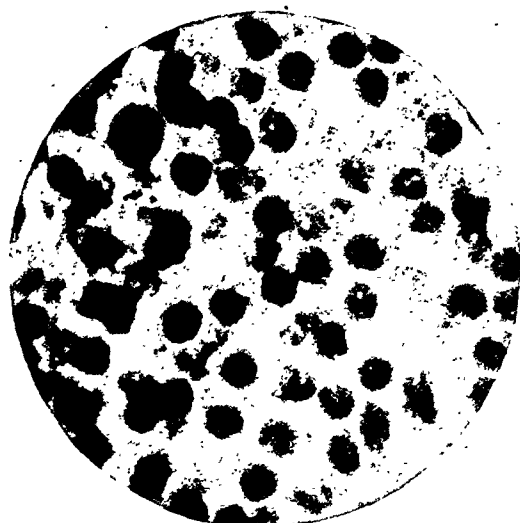


FIG. 5. Case IV. The nuclei are round, even and heavily dotted with chromatin; the cytoplasm is granular and without demonstrable pericellular membrane. Oil immersion magnification.

the right lower quadrant. The patient had been in good health except for occasional "abdominal cramps" of one year's duration. A month before, the patient had been seized with mid-epigastric pain which later localized in the right lower quadrant and lasted two days, after which she felt well until the night before admission, when the same symptoms, in more severe form, recurred, accompanied by nausea and vomiting. The past history was otherwise essentially negative.

*Physical Examination.* The abdomen was soft, without rigidity. Tenderness was present in the right lower quadrant without any rebound tenderness.

*Laboratory Findings.* The white cell count was 10,250, with 76 per cent polymorphonuclear leucocytes.

*Operation.* An appendectomy was performed. Complete recovery followed an uneventful course.

*Gross Pathology.* The appendix measured 6 cm. in length and 0.5 cm. in diameter. The serosa was smooth, but the blood vessels were congested. Beneath the submucosa, near the tip of the appendix was a bright yellow, freely movable resilient nodule measuring 0.5 cm. in largest diameter. The overlying mucosa was

forced into the lumen to approach the opposite wall.

*Microscopic Description.* Sections of the appendix showed clusters and nests of spheroidal cells separated by hypertrophic partially hyalinized bands of fibrous tissue. The nuclei were uniform, round and heavily dotted with chromatin. There were no demonstrable mitotic figures. The cytoplasm was granular; the pericellular membranes were not demonstrable. The muscularis and serosa were uninvolved and were separated from the tumor by an excess of hyalinized stroma. The entire section was congested, edematous and moderately sprinkled with polymorphonuclear leucocytes and lymphocytes. The granules of the cytoplasm showed affinity to silver.

*Diagnosis.* Acute appendicitis. Argentaffine tumor of the appendix.

*Comment.* This is a typical case of acute exacerbation of an old appendicitis associated with chromargentafline tumor.

CASE V. (Service of Dr. W. Friele.)

*Clinical Features.* Mr. P. L., 27, white male, was admitted to the hospital June 2, 1936. For the preceding three years, he had had epigastric pain immediately after eating; this pain was relieved by baking soda or vomiting. In the summer of 1935, he consulted a physician, but treatment did not yield improvement. One year later, after eating, the patient noticed pain stronger than usual. It remained in the right upper quadrant for two days, then settled in the right lower quadrant and became more severe. No nausea was present. Tenderness just to the right of the rectus muscle above the symphysis pubis was noted, and there was slight rigidity of the right rectus muscle.

*Laboratory Findings.* The stools were negative for occult blood. There was slight leucocytosis with 76 per cent polymorphonuclear leucocytes.

*Operation.* On June 20, 1936 the patient underwent an appendectomy, recovered completely and uneventfully.

*Gross Pathology.* The appendix measured 5 cm. in length and varied from 0.6 to 1 cm. in width. The serosa was smooth with congested blood vessels. On section, the lumen appeared occluded by a bright yellow, nodular mass 0.6 cm. in largest diameter.

*Microscopic Description.* Sections of the appendix showed a partially hyalinized stroma invaded by clusters, cords or anastomosing



FIG. 6. Case v. Low magnification. Polygonal cells with finely granular cytoplasm, closely simulating epidermoid cells.

masses of closely related polygonal cells with abundant, moderately eosinophilic, finely granular cytoplasm. The nuclei were round or oval with conspicuous perinuclear membranes, and were delicately dotted with chromatin material. The pericellular membranes were indistinct. The muscularis was atrophic and sharply separated from the tumor by a conspicuous amount of stroma. Scattered throughout were polymorphonuclear leucocytes, monocytes and lymphocytes. Silver impregnation showed an affinity of the cytoplasmic granules for silver.

*Diagnosis.* Acute appendicitis. Argentaffine tumor of the appendix.

*Comment.* The history was suggestive of peptic ulcer, but observation and radiographic detail pointed to appendicitis.

#### CONCLUSIONS

1. These tumors cannot be clinically diagnosed. They are merely incidental findings or are associated with chronic or acute appendicitis.

2. The innocence of carcinoid of the appendix is a conspicuous feature, even in the presence of serosal involvement, if the tumor is removed in toto. (All the patients are alive and well.)

3. These tumors are believed to arise from the chromargentaflne cells distrib-

uted in the stomach and intestines, especially in the appendix.

4. In our cases, multiplicity of the tumors was not noted.

I wish to thank Drs. E. Burke, M. Fellman and W. Friele for allowing me to abstract the cases.



THE various causes [of eventration of the diaphragm] are: congenital atrophy, dystrophy, neuromuscular degeneration following injury, neuritis or other involvement of the phrenic nerve or its fibers, certain infectious diseases and changes in the musculature of the diaphragm, such as pseudo-hypertrophic lipomatosis and myositis.

From—"Surgical Diseases of the Chest" by Evarts A. Graham, Jacob J. Singer and Harry C. Ballou (Lea & Febiger).

# JEJUNAL ULCER FOLLOWING GASTROENTEROSTOMY\*

## RESULT AFTER TWO YEARS

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**H** K., aged 42 years, was admitted to the Surgical Service of the Lenox Hill Hospital on July 31, 1934, complaining of pain in the lower abdomen, radiating from the right to the left side, at times cramp-like in character, and occasionally accompanied by distention.

The patient had had a gastroenterostomy performed for a duodenal ulcer at another hospital in 1929, and an appendectomy in 1932. The history as of 1929 was typical of a duodenal ulcer without, however, any hematemesis or melena. In the ten months previous to his operation, he had been treated medically but in spite of this lost 27 pounds. Immediately following the gastroenterostomy, he had some relief, but then began to be aware of a "dragging and annoying" feeling across his lower abdomen. This persisted, and in 1932, the appendectomy was done, although there were not, in his opinion, any symptoms referable to the appendix.

The patient dated the onset of the symptoms present at the time of his admission to Lenox Hill Hospital from the time of the gastroenterostomy. The dragging pain across the lower abdomen, which was not relieved by the appendectomy, became about July 1, 1934 more severe and cramp-like in character. It was not related to meals and was noticed particularly at night. Distention and belching were associated with it. High colonic irrigations were resorted to without benefit. The patient stated that, preceding relief from the attacks, he could feel something that seemed to slide over some obstructing object in his bowels, and that the movement seemed to be from left to right.

On July 29, 1934, following a very severe attack of pain that lasted from ten o'clock in the evening until two o'clock in the morning, he vomited and was relieved. His physician then recommended hospitalization.

Physical examination revealed a rather undernourished man of 40 of the asthenic type. The lungs and heart were normal. The abdomen was slightly distended, and somewhat tender throughout, with tenderness most pronounced just to the left of the umbilicus.

Wassermann and urine examinations were negative. The blood picture was of no special significance except for a slight secondary anemia with a hemoglobin of 70 per cent. Test meals showed hyperacidity, the free hydrochloric acid before and after the meal being 40 and 68, and the total acidity 55 and 84 respectively. No blood was found.

Roentgenographic examination of the gastrointestinal tract showed a stoma on a high level and the pyloric half of the stomach dilated and atonic because it could not empty through the stoma. The first portion of the duodenum was not satisfactorily outlined at any time and none of the barium was seen to leave through the pylorus. A diagnosis of chronic duodenal ulcer and probably chronic marginal ulcer was made.

On August 8, 1934, an operation was done with the preoperative diagnosis of gastrojejunal ulcer. On entering the abdominal cavity many adhesions were found, especially of the omentum to the anterior abdominal wall. After these were separated, the jejunum was found to be anastomosed high up on the posterior wall of the stomach. Further examination revealed a rather firm, indurated mass with ulceration at the site of the anastomosis adherent to the colon. In attempting to separate the jejunum from the adherent colon, the indurated and scarred tissue was torn, causing a small perforation of the jejunum at the site of the ulcer. The mesocolon was then dissected away and the lesser peritoneal cavity entered. An examination of the pyloric end of the stomach and the duodenum revealed no evidence of previous ulceration. As there appeared no valid reason

\* Presented before the New York Surgical Society, November 11, 1936.



why the normal relationship should not be restored, the gastroenterostomy stoma was resected and the opening in the stomach was closed.

Upon examination of the jejunal loop containing the ulcer, it was seen that a simple closure together with an excision of the ulcer could not be done. Therefore, about 5 inches of the jejunum were resected and an end-to-end anastomosis was done. The mesentery and the rent in the mesocolon were closed, and the abdomen was closed in layers.

The pathologic report of the specimen showed an ulcerated area 2 cm. in diameter near one edge of the opening which had been the stoma. The crater-like floor was covered by granulation tissue. The pathologic diagnosis was chronic ulcer of the small intestine.

In December of that year (1934) the patient stated that he was in excellent health, able to eat and drink everything without discomfort,

and that he had gained 30 pounds. He has remained well up to the present time.

The case is presented to show: (1) the inadvisability of doing a gastroenterostomy in the presence of a florid ulcer of the duodenum; (2) that an improperly placed stoma which prevents an easy emptying of the stomach can lead to serious complications; (3) that the diagnosis of chronic appendicitis should be made guardedly, and usually, unless there is definite historical evidence, only after the exclusion of other causative factors for the symptoms.

In the records of Lenox Hill Hospital from 1924 to date there are listed thirteen cases of gastrojejunal ulcer. Some of these patients had been operated upon previously at Lenox Hill and some at other institutions. As there were 227 cases of gastric and duodenal ulcers operated upon, this is about 5.7 per cent.



# MULTIPLE VESICAL CALCULI

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WHILE vesical calculi are no novelty in urologic practice, the finding of 1,368 calculi in one bladder is worthy of note.

and immovable. A diagnosis of carcinoma of the prostate was made. The urine was acid and cloudy, but became clear on heating. No albumin, sugar, pus, blood or casts were

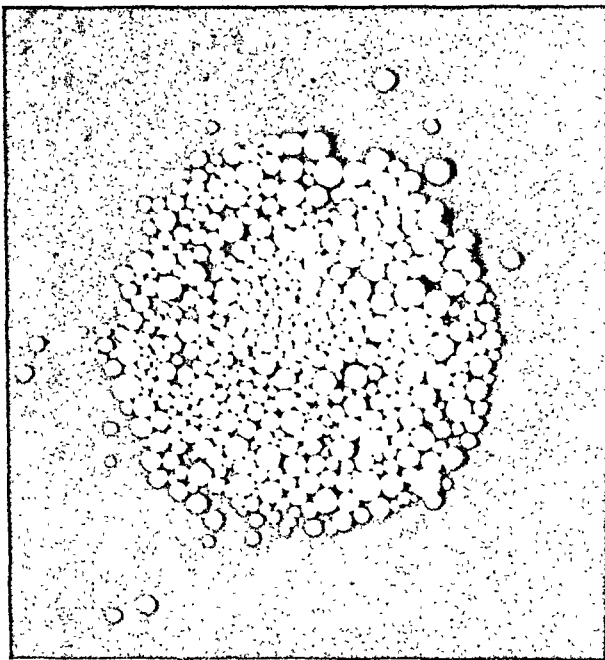


FIG. 1. Six hundred and four calculi removed at first cystoscopy.

## CASE REPORT

J. C., a white Italian male of 62 years, was admitted to the Long Island College Hospital, September 29, 1936, complaining of frequency, nocturia, dysuria, and difficulty in starting to urinate, of two years' duration. He had had dyspnea and palpitation of the heart on very slight exertion for the past four years. Otherwise, his past history was negative.

Examination revealed an extremely obese, soft, wheezy individual. The heart was markedly enlarged; the sounds were of good quality, and the pulmonic second sound was increased over the aortic sound. There were no râles. There was no peripheral edema. Peripheral vessels were sclerosed. Rectal examination revealed the prostate small, but very hard,

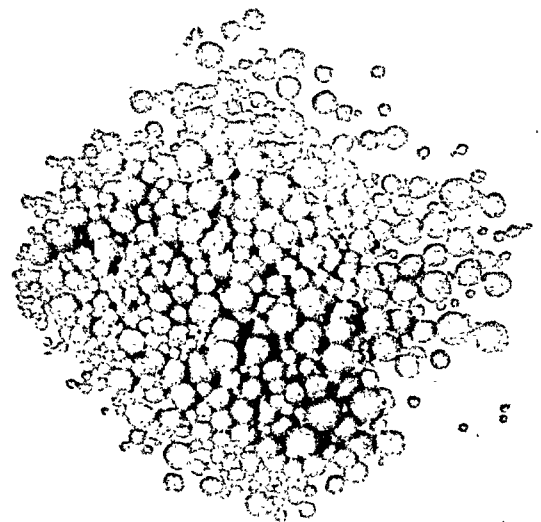


FIG. 2. Seven hundred sixty-four calculi removed at second cystoscopy. Note change of color due to instillation of argyrol.

present. The residual urine was 4 ounces. Blood chemistry was normal. The uric acid content was 2.4 mg. Blood Wassermann and Kahn tests were negative.

Cystoscopy was attempted under local anesthesia on the day of admission. The cystoscope was gripped so firmly at the bladder neck that very little motion was possible. Upon removing the obturator, urine containing many small, smooth, round calculi was evacuated from the bladder. By continuous washing, 604 of these calculi were removed. Observation of the bladder showed it to contain many more calculi of a size larger than those evacuated. Due to the discomfort of the patient, the procedure was discontinued. Argyrol was

instilled in the bladder before withdrawal of the cystoscope.

A plain x-ray film showed no evidence of calculi in the kidneys, ureters, bladder or prostate. Cystogram revealed a slight irregularity of outline of the bladder on the inferior aspect, which was unusual. The bladder showed so little elevation that it was questionable whether the findings were of significance. The presence of tumor infiltration was certainly possible.

On September 30, 1936, cystoscopy under spinal anesthesia was performed. Seven hundred and sixty four stones varying from about the size of a beebe shot to that of a marble were first evacuated, using a Bigelow aspirator. Due to instillation of argyrol into the bladder at the previous cystoscopy, the color of the calculi had changed from brown to black. Visualization revealed moderate trabeculation of the vesical musculatures. There were a few calculi, lodged in the interstices of the muscles, which were dislodged. The mucosa was healthy, the trigone was elevated, and there was a slight intravesical projection of the prostate. A McCarthy resectoscope was introduced and four pieces of tissue removed for biopsy. The pathologist's report on the excised tissue was carcinoma. An in-dwelling catheter was placed in the urethra and retained until October 3, 1936, when vesical neck resection was attempted under spinal anesthesia.

At the beginning of the operation the patient stopped breathing and the operation had to be discontinued. Efforts at resuscitation were eventually successful, and a retention catheter was once more applied.

The patient recovered so rapidly that he was discharged on October 7, 1936, in perfect comfort with no residual urine. At the present writing no further resection has been done as he is still without urinary symptoms, and carries no residual urine.

#### SUMMARY

A case of multiple vesical calculi is presented. There was no history of passing stones, although 1,368 were finally recovered from the bladder. The bladder was not grossly infected. The calculi were uric acid in composition and were not radio-opaque. Removal of the calculi, together with a very small vesical neck resection, provided complete relief of symptoms.

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# REPEATED ECTOPIC PREGNANCY SIMULATING INTESTINAL OBSTRUCTION

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## INTRODUCTION

THE following case is presented because of its unusual character and difficulty in diagnosis, with the aim of clarifying certain points in the diagnosis of ectopic pregnancy and helping others to avoid the difficulties encountered by the author. The case is one of repeated ruptured tubal pregnancy with secondary abdominal implantation, which simulated at times a picture of acute cholecystitis and cholelithiasis, and at other times a picture of low ileal intestinal obstruction.

## CASE HISTORY

V. S., a 43 year old Greek female, was admitted to the Cumberland Hospital on November 30, 1934 at 8:30 P.M., with a history of lower abdominal pains, nausea and vomiting for the previous month. The pains, located in the hypogastrium and both iliac quadrants, radiating upward and backward to both flanks and occasionally to the chest and both shoulders, came in attacks associated with nausea and, on several occasions with vomiting. Since 5:30 P.M. on the night of admission, the pains were quite severe and the patient was brought to the hospital by ambulance.

The patient also complained of weakness, dyspnea on exertion, poor appetite and a loss of eleven pounds during the month. She had pain at the onset of urination; there was frequency, but no burning or hematuria. She gave a history of constipation for a long time for which she had had recourse to pills or enemas. For one month, however, she had had pains on defecation. Her last bowel movement was in the morning of the day of admission.

The patient had her last regular menstrual period September 10, 1934, and flowed for three days. The next period was November 1, 1934. There was no period in October. This November period lasted only one hour and

occurred approximately three days after the onset of the lower abdominal pains. The last full term pregnancy had occurred four years before, and there had been no miscarriages.

*Past History.* The past history was entirely negative except for a right salpingectomy on June 13, 1925. At that time the patient had been admitted to Mercy Hospital in Pittsburgh for the relief of "pelvic pain." At operation "an old ectopic of the right side was found, forming an hematocele the size of a hen's egg, densely adherent in the cul-de-sac; the appendix was also adherent to the mass; the left adnexa was found to be normal; a fibroid, the size of a hen's egg, was present in the anterior wall of the uterus; the gall-bladder was negative."

A salpingo-oophorectomy, ventral suspension of the uterus and a myomectomy were done at this time. The patient's post-operative course was normal. The pathologic report of the specimens removed revealed "tubal gestation; fibromyoma of the uterus and chronic interstitial appendicitis." The condition of the patient and wound when discharged were reported as "good."

*Physical Examination.* On admission to Cumberland Hospital, examination revealed an acutely ill elderly Greek female, moderately pale, lying comfortably in bed, and not in acute pain. The temperature was 99°F. the pulse 80 per minute and of good quality. The tongue was pale and dry. The conjunctivae were pale. The chest revealed occasional subcrepitant râles at the left base. The heart sounds were poor, no murmurs were made out, and the rhythm was regular. The abdomen was slightly distended, diffusely tender throughout, most markedly so in the lower abdomen, and there was rigidity of the right rectus. On pulling the lower midline abdominal scar, marked tenderness was elicited. The epigastrium was tender to deep pressure and there was marked tenderness to percussion in both costovertebral angles.

Vaginal examination revealed the cervix to be slightly softened and tender to motion, the

uterus anterior, slightly enlarged and tender to motion. There was exquisite tenderness in both adnexae and in the posterior cul-de-sac, but no masses were palpated and no bleeding was evidenced. Urine examination on admission was negative. The white blood count was 11,200, with 80 per cent polys and 20 per cent lymphocytes. Sedimentation time was one hour and fifteen minutes.

At this time, in view of the anomalous menstrual period preceding the onset of the pain, the pallor and the vaginal findings, it was believed the patient might have a ruptured tubal pregnancy. However, several hours after admission to the hospital the clinical picture had entirely changed—the patient became very restless, began to complain bitterly of pain in the right upper quadrant and across the middle of her back. At this time, she still had diffuse abdominal tenderness, but there was marked tenderness in the right upper quadrant and pain was referred to the right shoulder on pressure over the gall-bladder region. Deep inspiration caused the patient to catch her breath because of aggravation of her generalized abdominal pain with radiation to both shoulders and the back.

In view of the change in the clinical picture at this time, with the localization of the most marked point of tenderness over the gall-bladder region, it was felt that the patient was suffering from a recurrent attack of cholecystitis with possible pancreatitis. It was decided to watch the patient further, and she was therefore given morphine and fluids parenterally.

*Pre-Operative Course.* During her entire course of careful observation over a period of several weeks, the patient ran an irregular low grade temperature to 101°F., with corresponding pulse. She continued to complain bitterly of pain in the right upper quadrant and epigastrium and had repeated attacks of vomiting. The tenderness in the epigastrium, under the right costal margin, and in the lower abdomen continued, and the abdomen became diffusely distended. The pain in the right upper quadrant finally subsided, but those in the lower abdomen and the epigastrium remained. The patient had difficulty in moving her bowels and had only partial results from repeated enemas. A flat plate of the abdomen at this time revealed "several gas distended loops of ileum in all the four quadrants of the abdominal cavity." It was felt the patient had chronic intestinal obstruction dependent on old pelvic adhesions.

Examination by means of barium enema failed to reveal any obstruction in the filling of the colon and attempts at a gastric series were unsuccessful because of the patient's weakness and persistent vomiting.

The patient gradually developed a definite pallor and examination of the blood revealed a red count of 2.1 million red blood cells and a hemoglobin of 35 per cent. In view of this, the patient was given a transfusion of 500 c.c. of whole blood, but there was apparently no improvement in her color or general condition. The abdomen remained distended and tympanitic throughout in spite of repeated gastric lavage and soap suds enemas. The patient developed a pasty yellow color and slight jaundice of her sclera; a second transfusion of 380 c.c. of whole blood was again given.

*Operation.* In view of the persistence of the anemia in spite of several transfusions and the development of a slight jaundice, it was felt finally, after prolonged observation, that the patient had some form of concealed hemorrhage, probably a ruptured ectopic. On December 20, 1934, she was operated upon and an intra-abdominal pregnancy of three to four months' duration was found, with the peritoneal cavity filled with a large amount of blood, both old and fresh. The placenta, the size of a grapefruit, filled the entire pelvis and was adherent to the intestines and omentum. In the attempt to free this mass in order to get at the site of the hemorrhage, a 3 to 4 month old fetus was found lying in the abdominal cavity. The mass, together with several large blood clots, was removed and the bleeding was controlled with mass ligatures and suture ligatures. The stumps of the left tube and ovary were removed, the free ends sutured, and an iodoform pack was placed against the placental site to control the bleeding. The abdomen was closed in the usual manner and the patient was given another transfusion of 500 c.c. of whole blood.

*Post-Operative Course.* Immediately after operation the patient ran a persistent temperature between 103 and 104°F. with a corresponding pulse of fair quality. The wound drained a profuse amount of serosanguinous material. The abdomen again became markedly distended, but at times this could be relieved by continuous gastric suction combined with enemas. Diffuse wheezes throughout the chest were heard and there was a mucoid expectoration. Her general condition did not improve in

spite of all supportive treatment. She had persistent vomiting and developed an extremely marked and tense abdominal distention. On the twelfth day after operation, she developed numerous moist râles in her chest with a frothy bloody expectoration, indicative of pulmonary edema. This caused death.

*Pathologic Report.* Pathologic examination of the specimen removed at operation was described by Dr. S. H. Polayes as follows:

"Specimen is a fetus measuring about 4.5 cm. in length with well defined digits and almost completely developed genitalia. This is accompanied by masses of placental tissue weighing 335 Gm. Together with the placental tissue is found an irregular mass containing fat and necrotic hemorrhagic structure. Microscopic examination reveals that the tissue consists of a large amount of blood clot and fibrin network which surrounds areas of degenerated chorionic villi. In some portions there are large syncytial masses present. The accompanying omental tissue is the seat of acute inflammatory infiltration and marked hemorrhage. *Diagnosis:* Intra-abdominal pregnancy; degenerated placental tissue; acute inflammation of the omentum."

#### DISCUSSION

While cases of repeated extra-uterine gestation in the same patient are not an uncommon occurrence, its occurrence in this case serves to emphasize again, as some authors have done, the importance of pathology in the opposite adnexa or the uterus as a probable cause for repeated ectopic pregnancies. It is interesting to note that the very first recorded case of extra-uterine gestation, that of Albucasis in the middle of the eleventh century, was one of repeated extra-uterine pregnancy, according to William Campbell.<sup>1</sup> "Albucasis, as may be learned from his writings, simply states the fact of an abscess having formed at the umbilicus from which fetal bones had been extracted, in a patient in whose uterus the fetus died in two successive pregnancies. . . . And as it is said that in both pregnancies the fetus had died in utero, it might be supposed that in consequence of rupture of the organ, they had, thereafter, on one or

both occasions escaped into the abdominal cavity; but as the narration of the case does not bear that the patient met with any accident, and that there are no symptoms mentioned characteristic of such an injury, or of retroversion of the uterus even, the inference is perfectly legitimate that in both gestations the ovum had not entered the uterus, but had been retained in one of its appendages, or developed in connection with them in the peritoneal cavity."

It is also extremely interesting to note that the earliest case of abdominal section for ectopic pregnancy which has been found on record is that of Primerose,<sup>2</sup> who operated in October 1594, on a woman, aged 30, who after seven normal gestations, had two extra-uterine pregnancies, the first of which evacuated itself spontaneously through the abdominal wall. Parry<sup>3</sup> in discussing "gastrotomy" as a measure in the treatment of extra-uterine pregnancy, states: "The earliest case which we have been able to find upon record is that of Primerose, who operated in October 1594. The history of this patient has become classic. She was twice pregnant with extra-uterine children—first in 1591 and again some time before 1594. The cyst of the first child opened spontaneously through the abdominal wall. The fistula was enlarged, and this child extracted by Jacob Noierus, a surgeon. This operation proving successful, Primerose removed the second infant by gastrotomy two months later. It is easy to imagine how he was led to perform the second and more hazardous operation."

The incidence of repeated ectopic pregnancies has been variously reported by different authors as ranging from 1 to 16 per cent. This may be due to differences in opportunities for following up these patients, as illustrated in the case presented, where the patient was operated upon a second time in a different hospital in another city.

There seems to be a very definite number of patients with ectopic pregnancies who

INCIDENCE OF REPEATED ECTOPIC PREGNANCIES

Author	Total Number of Cases	Number of Cases of Repeated Ectopics	Per cent of Repeated Ectopics
R. R. Smith <sup>4</sup> .....	144	21	14.5
Am. Gynec. Soc. <sup>4</sup> ...	1608	58	3.6
Literature to 1914 <sup>4</sup> ...	1390	55	4
Giles <sup>5</sup> .....	39	5	12.8
Brady <sup>6</sup> .....	50	2	4
Behney <sup>7</sup> .....	167	2	1.2
Sheffey <sup>8</sup> .....	82	5	6.09
Urdan <sup>9</sup> .....	474	27	5.7

will be candidates for a repetition of this catastrophe on the opposite side. Schuman<sup>10</sup> concludes from examining 280 cases, that "about one woman in eight who had had one extra-uterine pregnancy may expect another." Not only is she subject to another ectopic gestation in the opposite tube, but Hassenblatt<sup>11</sup> collected twenty-one cases of recurrence in the same tube, many occurring in the stump after salpingectomy. The reason for the incidence of recurrent extra-uterine pregnancy is given by Schumann.<sup>10</sup> "The causes underlying tubal pregnancy are frequently identical in both tubes and should one tube be removed for the relief of this condition, it is reasonable to suppose that the other tube may be similarly affected at some subsequent period." I. C. Rubin<sup>12</sup> examined the status of the residual tube following ectopic pregnancy by means of tubal insufflation with gas, and found that of ninety patients examined, "only 12.35 per cent of the ninety tubes were normally patent, 43.21 per cent were completely obstructed, and 44.44 per cent were partially obstructed." Because of this, many authors have recommended removal of both adnexae at the time of operation for the ectopic gestation.

The incidence of pathology of the opposite tube noted at the time of operation, is about the same as repeated ectopic pregnancy occurring in these cases. Urdan<sup>9</sup> noted that, of 474 cases, 10.3 per cent presented evidence of tube pathology on

the other side. Lavell<sup>13</sup> observed that chronic inflammation of the opposite tube was noted in eighty-one instances of 419 cases examined. Sheffey<sup>8</sup> found as high as 39 per cent of eighty-two cases of ectopic pregnancy had abnormalities in the opposite adnexa at the time of operation. It is for these reasons that Smith<sup>4</sup> recommends removal of the opposite tube when children are not desired. I. C. Rubin<sup>12</sup> comes to the conclusion that at the time of operation, "the uninvolved tube should be carefully scrutinized, and if it is hopelessly diseased, and the patient has borne a child, it should be removed. If only partially impaired, it should be left in situ because intra-uterine pregnancy occurs more often under such conditions than tubal pregnancy." Shumann and Rubin both found that an intra-uterine pregnancy occurs four times more frequently following an ectopic than does a subsequent ectopic. "The age of the patient, her parity, and her desire to bear more children, should influence and determine the procedure."

The reason for the upper abdominal manifestations and pain in the back and shoulder in our case is quite evident. The patient had a massive intraperitoneal hemorrhage, and since she was in dorsal decubitus position, the blood rapidly spread to the upper abdomen, irritating the under surface of the diaphragm and posterior parietal peritoneum. The pain was therefore referred to these irritated points. Pain in both shoulders is due to the fact that the under surface of the diaphragm, irritated by the blood, is supplied by the same nerves (C3, 4, 5), as those to the skin of the outer aspect of the shoulders. Pain in the shoulder due to blood in the abdomen, is frequently referred to as Laffont's sign, for Laffont<sup>14</sup> noted extra-pelvic referred pain which was located in the epigastrium, infracostal region, shoulder, retrosternal and interscapular regions, and in the base of the neck in sixteen cases in which the abdomen was filled with blood. The incidence of upper abdominal manifestations in recorded cases of ectopic

pregnancies is not insignificant. Of 410 cases of ectopic where radiation of pain was specified, Lavell<sup>13</sup> found eighteen who referred their pain to the upper abdomen. And of 474 cases, Urdan<sup>9</sup> found twelve had pain in the upper abdomen.

The occurrence of jaundice in our case was misleading, whereas it should have been confirmatory. The hyperbilirubinemia occurs as the result of the absorption of the intraperitoneal blood. Some authors have used this as a confirmatory laboratory finding in questionable cases of ectopic pregnancy with hemorrhage. Dumphy and Fallon<sup>15</sup> in discussing the diagnosis of extra-uterine pregnancy, pay special attention to this, and use this as a confirmatory sign. "It is well known that jaundice may occur from intraperitoneal hemorrhage. One of our errors in diagnosis (in forty-two cases of extra-uterine pregnancy) was made chiefly because of the presence and misinterpretation of jaundice. At operation, it was evident that the jaundice was due to absorption of old blood (bile pigment). Afterward, visible jaundice was observed in four cases of extra-uterine pregnancy, and in three cases of intra-abdominal hemorrhage from other causes. In eight of twelve of our recent cases of extra-uterine pregnancy, the serum bilirubin was found well above normal. We discovered that this was a very important sign and that in the decision of a doubtful case, it is a diagnostic sign when present."

No case was found of ruptured ectopic pregnancy, fully described in the literature, that simulated intestinal obstruction as well as did the one here reported. The patient continued to vomit, remained moderately to markedly distended and had only slight and infrequent bowel movements with enemas, during the whole period of her observation. The reason for this is quite evident, when one recalls the findings at operation. The placental mass, blood clots and fetus were intimately adherent to loops of intestine, parietal wall and omentum in the lower half of the abdomen and pelvis. Back in 1889, E. E.

Montgomery, in discussing the treatment of ectopic gestations in Lawson Tait's Monograph,<sup>16</sup> described exactly such conditions. "In the peritoneal or abdominal form, the envelope of the fetus is partially composed by the gluing together of the intestinal loops and viscera of the abdomen in proximity to it. In such cases, the symptoms will depend largely upon the site of the placenta. If in its growth it becomes attached to the intestines, it generates such a congestion of the intestinal structures as to lead to violent catarrhal symptoms, such as vomiting, purging, and frequently recurring severe intestinal pains. The only relief is the arrest of the vitality of the ovum." To accomplish this, he recommended electricity or the faradic current.

Behney,<sup>7</sup> in discussing three deaths in 167 cases of ectopic, states that there was one admitted with intestinal obstruction, complicating an old ruptured extra-uterine pregnancy. Urdan,<sup>9</sup> analyzing the fourteen cases that died post-operatively among 474 cases of ectopic, found that "two cases died of intestinal obstruction." Many more cases of secondary abdominal pregnancy probably give rise to the picture of intestinal obstruction, especially before the fifth month, before fetal parts can be made out or the fetal heart heard, by reason of the wide attachment of the placenta and the organization and fibrosis produced by the blood clots, but no statistics are available. The clinical picture must be of sufficient frequency to be kept in mind, i.e., that secondary abdominal pregnancy due to ruptured tubal pregnancy may simulate intestinal obstruction by its persistent vomiting, distention, colicky pains and obstipation.

#### SUMMARY

A case of repeated ruptured tubal pregnancy with secondary abdominal implantation which simulated a case of low ileal obstruction is here presented. The incidence of repeated ectopic gestations is discussed, and the importance of examination



of the opposite tube is emphasized in determining the operative procedures to be carried out at the time of operation. The reasons for the clinical findings in this case are mentioned with the aim of emphasizing the importance of shoulder pain, jaundice, midline colicky pains, together with vomiting, distention and obstipation, in the diagnosis of the obscure case of the less dramatic type of ectopic pregnancy.

I take this opportunity of thanking Dr. John E. Jennings for the privilege of presenting this case, and Dr. Chester L. Davidson, on whose service the case was followed.

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# PERFORATED APPENDICITIS SECONDARY TO A COMMON STRAIGHT PIN

## REPORT OF A CASE

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*History.* F. B., a girl of 17, was admitted to the Reading Hospital January 20, 1937 at 10 P.M. Her chief complaint was sharp pain

with marked rigidity in the lower abdomen, particularly on the right side. The hymen was intact. On digital rectal examination there was some tenderness on the right side.

The urine was normal. A complete blood count showed: hemoglobin 92 per cent; red blood cells 4,500,000; white blood cells 9,400; color index .9; polymorphonuclears 84 per cent; small mononuclears 14 per cent and transitionals 2 per cent.

A diagnosis of acute appendicitis was made and the patient promptly operated upon.

*Operation.* Under spinal anesthesia a short right rectus incision was made, and the lower portion of the cecum brought up. The appendix easily came into view, and at once a narrow sharp black object on the anterior aspect was visible. (Fig. 1.) It had perforated the appendix and was easily visible for a quarter of an inch. The appendix was large, red and indurated, particularly the middle one-third. A large portion of the serosa was covered with a yellowish plastic exudate. The appendix was removed by clamp and cautery and the base doubly ligated. The abdomen was closed in layers.

*Pathologic Examination.* The specimen consisted of an appendix weighing 8 Gm. and measuring 5 cm. in length with a uniform diameter of 1 cm. The serosa was dull, pinkish red and finely granular, with a thin yellowish plastic exudate. From a middle perforation, the point of a straight pin measuring 2.8 cm protruded. The wall was thickened with fibrosis and edema, and the mucosa was reddish pink with punctate hemorrhage. The lumen was patent with a serosanguinous exudate and contained the pin mentioned.

*Postoperative Course.* The postoperative convalescence was entirely uneventful. The patient was allowed out of bed on the seventh day and was discharged from the hospital on the ninth day. She continued to do well and went back to work at the end of three weeks.



FIG. 1.

in the lower part of the abdomen on the right side. The patient had become aware of the pain for the first time at 2 A.M. of the same day. After about six hours the pain had become so severe that it caused her to double up, and this continued until her admission to the hospital. There was no associated nausea or vomiting. The bowels moved normally the day prior.

The previous medical history was entirely negative except for convulsions in infancy. She had never had any operations nor was there any history of accidents. Upon questioning, no history was obtained of having swallowed a pin nor of using pins in her work as a helper in a shirt factory.

*Examination.* The patient was a young, white female, well developed, and of excellent general appearance with, however, a manifest expression of severe distress.

The blood pressure was 126 systolic, 84 diastolic; the temperature, 101°F.; the pulse 105 and the respiration rate 22.

The examination of the head and neck was grossly negative, as was also the examination of the chest. The abdominal examination revealed a generalized resistance throughout,

# TOTAL REMOVAL OF THE PATELLA

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THE number of procedures suggested for treating comminuted and compound comminuted fractures of the patella shows that the whole subject is still open for discussion. If our aim is to restore the patient to economic usefulness in the shortest possible time, improvement on the usual methods must be tried. Total removal of the patella is not widely practiced by the profession; therefore reports of isolated cases seem justified.

My attention was first called to this procedure during the war.<sup>1</sup> An early case was reported by C. C. Rogers.<sup>2</sup> Rynard<sup>1</sup> states that Althmann removed almost all the patella in 1890 with perfect function, and that Turner in 1886 removed the entire patella and sutured the quadriceps tendon to the patellar tendon, but movements of the knee were very limited. A recent article by Blodgett and Fairchild<sup>3</sup> reports a large series of cases, and contains many references to the literature and helpful suggestions. Naturally the lateral tears in the capsule must be carefully sutured. If this is done it seems entirely possible to have a good knee with the patella completely gone.

## CASE REPORT

J. A., age 24, on September 26, 1936, while riding a motorcycle, crashed into the side of an automobile. His only serious injury was to the left knee. There was a 7 inch lacerated wound in the midline, opening the knee joint. The patella was badly comminuted, the anterior crucial ligament torn loose, the semilunar cartilages broken into small bits, and a part of the internal condyle broken off and hanging

from the wound. Every part was contaminated with street dirt ground into the tissues.

Under general anesthesia a thorough cleansing was done, using green soap, followed by copious irrigations with saline solution. A thorough débridement was done. As the internal condyle was hanging by a mere thread of periosteum this was removed; all of the fragments of the semilunar cartilage were picked out of the joint. The torn crucial ligament was ignored. The different pieces of the patella were removed and a closure of the knee joint done by side-to-side suture with chromic gut. There was considerable undermining of the subcutaneous tissues of the lower thigh. These areas were opened widely and soft rubber drains inserted. The leg was put on a posterior plaster splint in extension. Tetanus and gas antitoxins were given.

The wound never showed any sign of infection, though the temperature ranged from 100 to 103 for eight days. (I believe this was reaction to the antitoxins.) After the eighth day the temperature was normal. Active motion was started after three weeks in bed. The patient was walking with crutches in six weeks, and within a few days the crutches were discarded. At the end of three months he walked without a limp, and could walk up and down stairs normally. Extension was normal but flexion was limited 25 per cent. At six months, flexion had improved another 10 per cent, and he had been back at work for a month. The knee does not buckle nor does it hurt. There were enough complicating factors to account for the small loss of flexion.

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# NEW INSTRUMENTS

## AN APPLICATOR FOR THE USE OF THE ELLIOTT TREATMENT IN THE LARGE INTESTINE THROUGH THE COLOSTOMY STOMA

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WE wish to describe an apparatus which we have devised for the direct application of heat to the wall of the large intestine through a colonic stoma. The principle is exactly the same as that used in the Elliott treatment for pelvic inflammatory disease. The applicator is made of rubber and allows a continuous circulation of water from the Elliott machine.

Figure 1 illustrates the construction and dimensions of the type of applicator which we have used in certain cases, together with a picture of the apparatus in situ. The rubber pouch is saddle-shaped to conform to the usual disposition of the bowel at the site of the colostomy. With a curved forceps one limb of the applicator is passed into the proximal limb of the loop while it is empty and the other limb is similarly placed in the distal limb of the loop. The point of junction of the two limbs rests directly on the spur between the two limbs of the loop of bowel, an important position for centering the heat. Adhesive tape may be used about the neck of the applicator to keep it in place. Usually, however, inflation of the applicator distends its limbs sufficiently to prevent its extrusion through the colonic stoma. The size of the applicator may be varied to the conditions needed; those dimensions given in Figure 1 are adequate for general use. An important point in construction is the size of the solid, non-distensible neck which is embraced by the colonic stoma when the apparatus is in position. (Fig. 1.) The neck of the

applicator must not be too large, since the abdominal stoma frequently will be found to be small.

We have given the treatment to patients for periods varying from thirty to sixty minutes, using water at 120°F. under a pressure of from 1 to 2½ pounds. The treatments are well tolerated. Abdominal cramps, distention or other annoying symptoms have not been encountered. The patients experience the same general sensations as those which are encountered during the vaginal Elliott treatment.

The application of heat directly to the intestinal wall is especially useful in hastening subsidence of inflammation and edema which involve the intestine at the site of operation. For example, after the Mikulicz type of colonic resection or extraperitoneal resection with the three-bladed clamp, the two approximated loops of bowel frequently are the site of considerable inflammatory edema. In time the edematous inflammation subsides so that the partition between the two approximated loops can be broken down by the application of clamps and the continuity of the intestine restored. Clamps cannot be effectively applied to the edematous, thickened spur so frequently encountered and deliberate delay often is indicated between the successive steps which lead ultimately to closure of the colonic stoma and restoration of normal fecal current.

In this type of surgical procedure involving separate steps, the application of heat by the Elliott apparatus is helpful in

restoring the intestinal wall to its normal condition and thus hastening completion of the surgical treatment. After a few applica-

has been no carriage of feces over into the distal loop, successive Elliott treatments will result in "melting" of the spur and the

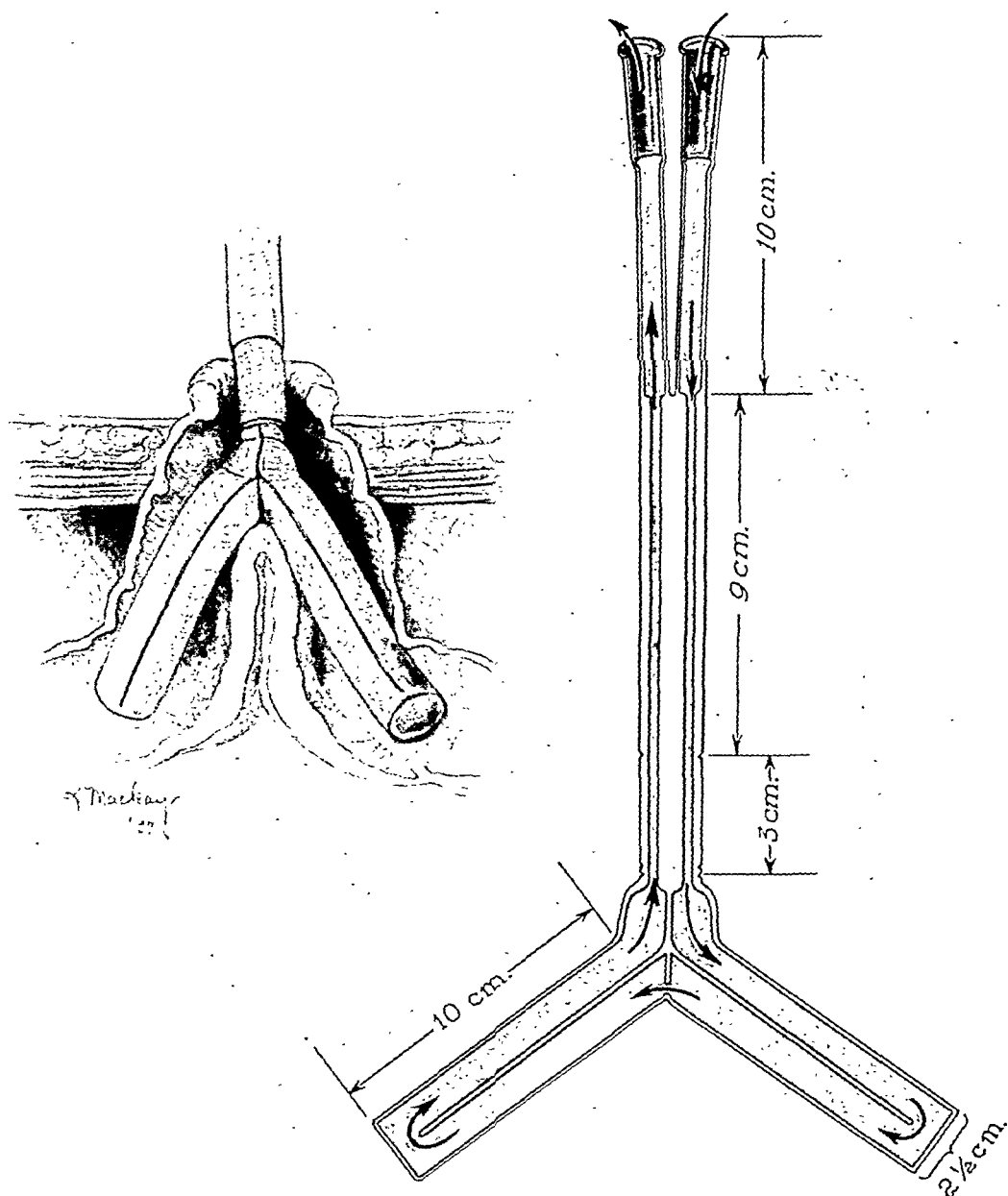


FIG. 1. Applicator for direct application of heat to large intestine: right, construction and dimensions of applicator; left, applicator in situ.

tions of heat through the stoma, the spur is found to be less thick than before and the adjoining segments of bowel are more pliable. If the spur is only partial, yet there

patient will have movements of feces through the normal channel in a surprisingly short time. In cases in which all feces have been passing through the colonic

stoma, the patients have had rectal movements of more than half of the total feces after a short series of such treatments and there also has been marked shrinking of the colonic spur.

The applicator, with suitable modifications, may also find usefulness in the treatment of diverticulitis of the colon in those cases in which colostomy has to be performed to divert the fecal current. It can be used in conjunction with a rectal applicator, as described by Pemberton and Waugh.

The apparatus has many advantages over injections of hot water. Since, when the applicator is used, water does not come in direct contact with intestinal epithelium, irritation is avoided, an important factor is lessening the effectiveness of injections of water. The temperature of the water and its pressure in the applicator can be accurately controlled.

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CATARRHAL or mucous proctitis is often associated with a like condition in the colon, and is characterized by a feeling of tenesmus, with a glairy white discharge which usually dries around the anus and is a fruitful source of pruritus.

From—"The Science and Practice of Surgery" by W. H. C. Romanis and Philip H. Mitchiner, 6th Ed. (Churchill).

# A SIMPLE SUCTION SIPHONAGE APPARATUS

W. A. WRIGHT

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THE usefulness of simple water suction siphonage in the treatment of a variety of conditions is now generally

raised edge around the top. It also has a low shelf on which the floor bottle may be set. The table is mounted on rubber wheels

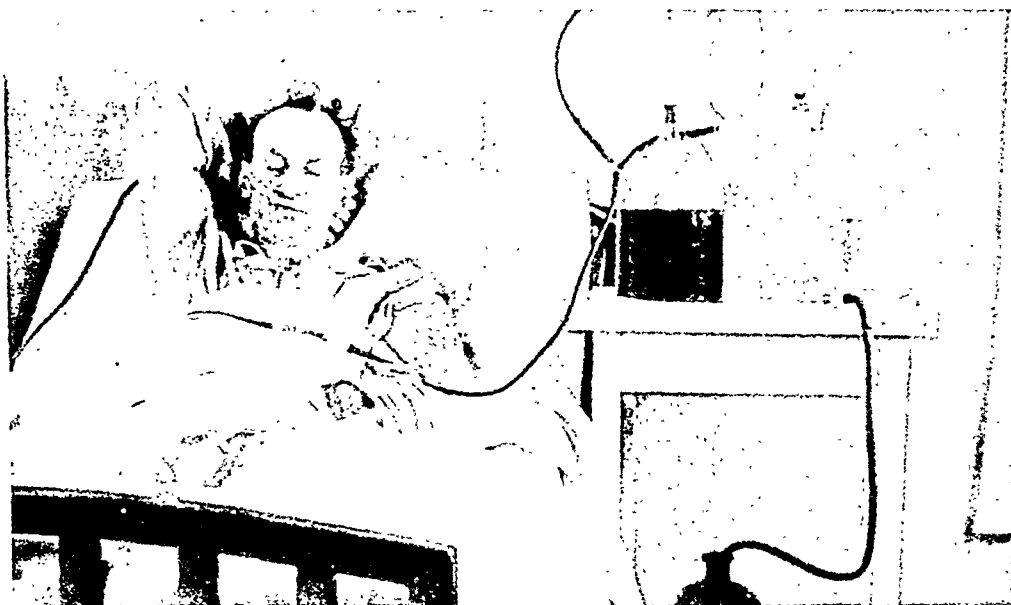


FIG. 1.

recognized. Introduced by Wangenstein<sup>1</sup> it has found its most common use in gastrointestinal decompression, usually with the Levin tube. For several years I have been using a set-up which is simple, inexpensive, and requires a minimum of attention.

As shown in Figure 1, it consists of the usual bottle on the floor connected to the suction bottle which has a stout glass nipple projecting from its base. The tubing leading from the floor bottle is connected to this nipple. Hence, the suction bottle stands upright on any convenient stand or table, and as it also has a fairly large opening at the top, it is a very simple matter to pour water into it from any pitcher. The mouth is filled with a one-hole cork having a connection leading to the collecting bottle which has a two-hole cork. Through the other hole, a connection is made with a Levin tube. As shown, there is a "Y" interposed to facilitate irrigation when desired.

I have had constructed a small wooden table 43 by 21 by 17 inches with a low

and the whole outfit may be kept connected, wheeled to the bedside and put in operation in a short time and with a minimum of effort.

While the apparatus is in use, the only attention required is to pour water from the floor bottle to the suction bottle and to empty and clean the collecting bottle. The use of a collecting bottle, while not essential, is advantageous for the following reasons:

1. Aspirated material may be measured and, if desired, readministered.
2. It is difficult to keep the suction bottle clean around the glass nipple; hence it is better to have only water in it.

The special bottle with glass nipple may be obtained from the Physicians and Hospital Supply Co., 412 South Sixth Street, Minneapolis, Minnesota.

## REFERENCE

1. WANGENSTEEN, O. H., and PAINE, JOHN R. Treatment of acute intestinal obstruction by suction with duodenal tube. *J. A. M. A.*, 101: 1532 (Nov. 11) 1933.



[From Fernelius' *Universa Medicina*, Geneva, 1679.]

# BOOKSHELF BROWSING

## THE UNEQUAL MARRIAGE\*

WITH BIOGRAPHY

JOSEPH HILTON, M.D., F.A.C.S.

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### THE ARGUMENT

THE unequal Marriage exposes to View the Folly of People in common, who in their *Espousals* chiefly regard the Greatness of the Fortune, and disregard the Diseases of the Husband, tho' they are worse than the Leprosy itself. The Description of a deform'd Man. That the Cruelty of Parents in matching their Daughters, is worse than that of *Mezentius*, of which *Virgil* writes in his Tenth Book of *Aeneids*. He describes the Vices of a bad Husband; that this is not marrying a Man, but a dead Carcass. In getting Dogs, Calves, and Horses, they take Care to have one strong Beast copulate with another, good ones with those that are like themselves; nor won't suffer a diseas'd one to leap a sound one. That the Commonwealth sustains a great Detriment by these foolish and unhappy Marriages.

PETRONIUS AND GABRIEL

Pet. Whence is our *Gabriel* come, with this sour look? what, is he come out of *Trophonius's Cave*?

Ga. No, I have been at a Wedding.

Pet. I never saw a Look in my life that had less of the Air of a Wedding in it; for those that have been at Weddings, use to look cheerfully and airily for a whole Week, and old Men themselves to look younger by ten Years. What Wedding is it that you have been at? I believe at the Wedding of Death and the Cobler.

Ga. Not so, but of a young Gentleman with a Lady of Sixteen, who has all of the Accomplishments that you can wish for, whether Beauty, good Humour, Family, or Fortune; in short, a Wife fit for *Jupiter* himself.

Pet. Phoo! what, so young a Girl to such an old Fellow as he?

Ga. Kings don't grow old.

Pet. But what makes you so melancholy then? It may be you envy the Happiness of the Bridegroom, who has rival'd you.

Ga. Pshaw, there's nothing of that in the Matter.

Pet. Well then, has any Thing happen'd like what is related of the *Lapithae's* Feast?

\* From the translation of Erasmus by N. Bailey, publ. by Reeves & Turner, London, 1878.



Ga. No, not so neither.

Pet. What then, had you not Wine enough?

Ga. Yes, and too much too.

Pet. Had you no Pipers?

Ga. Yes, and Fiddlers too, and Harpers, and Trumpeters, and Bagpipers.

Pet. What was the Matter then? Was not *Hymen* at the Wedding?

Ga. They called loudly for him with all this Musick, but to no purpose.

Pet. Were not the *Graces* there neither?

Ga. Not a Soul of them, not Bridemaid *Juno*, nor beautiful *Venus*, nor *Jupiter Gamelius*.

Pet. By my troth, you tell me a story of a dull Wedding indeed, an ungodly one, or rather an unmarried Marriage.

Ga. You would have said so indeed, if you had seen it.

Pet. Had you no dancing at it?

Ga. No, but we had wretched limping.

Pet. What, had you no lucky Godship at all to exhilarate the Wedding?

Ga. No, not one there but a Goddess, that the *Greeks* call *Psora*.

Pet. Why, you give me an Account of a scabby Wedding indeed.

Ga. Nay, a cankered, and a pockey one.

Pet. But, prithee, Friend *Gabriel*, tell me, What makes the Remembrance of it fetch Tears from your Eyes?

Ga. Ah! dear *Petronius*, it is enough to fetch Tears from a Flint-Stone.

Pet. I believe so, if a Flint-Stone had been present, and seen it. But prithee, What extraordinary Mischief is this? Don't hide it from me, nor keep my Expectation any longer in Suspense.

Ga. Do you know *Lampridius Eubulus*?

Pet. Yes; there is not a better nor happier Man in the City.

Ga. Well, do you know his daughter *Iphigenia* too?

Pet. You have mentioned the very Flower of the Age.

Ga. She is so; but, do you know who she's married to?

Pet. I shall know when you have told me.

Ga. She is married to *Pompilius Blennus*.

Pet. What, to that Hector, that us'd to talk Folks to Death in cracking of his bullying Tricks?

Ga. To the very Man.

Pet. He has been for a long Time very noted in this Town, to two Things chiefly, i.e. Lying, and the Mange, which has no proper Name to it, tho' indeed it has a great many.

Ga. A very proud Distemper, that won't strike Sail to the Leprosy, the Elephantine Leprosy, Tetters, the Gout, or Ringworm, if there was to be an Engagement between them.

Pet. So the Sons of *Esculapius* tell us.

Ga. What Need is there, *Petronius*, for me to describe to you a Damsel that you are very well acquainted with? altho' her Dress was a great Addition to her native Beauty. My *Petronius*, you would have taken her for a Goddess, had you seen her. Everything in her and about her was graceful. In the mean Time out comes our Blessed Bridegroom with his Snub-Nose, dragging one Leg after him, but not so cleverly neither as the *Switzers* do; itchy hands, a stinking Breath, heavy Eyes, his Head bound up with a Forehead-Piece, and a Running at his Nose and Ears. Other People wear their Rings on their Fingers, but he wears his on his Thighs.

Pet. What was in the Mind of the Lady's Parents, to join such a Daughter to a living Mummy?

Ga. I can't tell, except it was with them, as it is with many more, that have lost their Senses.

Pet. It may be that he was very rich.

Ga. He is very rich indeed, but it is in the Debts he owes.

Pet. What greater Punishment could they have inflicted upon the Maid, if she had poison'd her Grandfathers and Grandmothers, both of the Father's and Mother's Side?

Ga. Nay, if she had scatter'd her Water upon the Grave of her Parents, it

would have been a Punishment bad enough to have oblig'd her but to have given a Kiss to such a Monster.

Pet. I am of your Mind.

Ga. I look upon it a greater Piece of Cruelty, than if they had stripp'd their Daughter naked, and expos'd her to Bears, Lions, or Crocodiles: For these wild Beasts would either have spar'd her for her exquisite Beauty, or put her out of her Pain by a quick Dispatch.

Pet. You say right: I think this is what would have become *Mezentius* himself, who, as *Virgil* tells us, *bound dead bodies to living ones, Hands to Hands, and Moutbs to Moutbs*. But I don't believe *Mezentius* himself would have been so inhuman as to have bound such a lovely Maid to such a Carcass as this: Nor is there any dead Body you would not chuse to be bound to, rather than to such a stinking one; for his Breath is rank Poison, what he speaks is Pestilence, and what he touches mortifies.

Ga. Now, *Petronius*, imagine with yourself what a Deal of Pleasure she must needs take in these Kisses, Embraces, and nocturnal Dalliances.

Pet. I have sometimes heard Parsons talk of unequal Matches; that may certainly with greatest Propriety be call'd an unequal Match; which is, as it were, setting a Jewel in Lead. But all this While I stand in Admiration at the Virgin's Courage; for such young Damsels are frightened out of their Wits at the Sight of a Fairy or a Hobgoblin; and can this Damsel dare to embrace such a Carcass as this in the Night-Time?

Ga. The Damsel has these three Things to plead in her Excuse: The Authority of her Parents, the Persuasion of her Friends, and the Unexperiencedness of her Age. But I am amaz'd at the Madness of her Parents. Who is there that has a Daughter never so homely, that would marry her to a Leper?

Pet. No Body, in my Opinion, that had a Grain of Sense. If I had a Daughter that had but one Eye, and but one Leg, and as deform'd as *Thersites* was, that *Homer* speaks of, and I could not give her a Penny for her Portion, I would not marry her to such a Son-in-Law as he.

Ga. This Pox is more infectious and destructive than the worst of Leprosies: It invades on a sudden, goes off, and rallies again, and frequently kills at last; while the Leprosy will sometimes let a Man live, even to extreme old Age.

Pet. Perhaps the Parents were ignorant of the Bridegroom's Distemper.

Ga. No, they knew it very well.

Pet. If they had such a Hatred to their Daughter, why did they not sew her up in a sack, and throw her into the *Thames*?

Ga. Why truly if they had, the Madness would not have been so great.

Pet. By what Accomplishments did the Bridegroom recommend himself to them? Was he excellent in any Art?

Ga. Yes, in a great many; he's a great Gamester, he'll drink down any body, a vile Whoremaster, the greatest Artist in the World at bantering and lying, a notable Cheat, pays no body, revels prodigally; and in short, whereas there are seven liberal Sciences taught in the Schools, he's Master of more than ten liberal ones.

Pet. Sure he must have something very extraordinary to recommend him to the Parents.

Ga. Nothing at all, but the glorious Title of a Knight.

Pet. A fine Sort of a Knight, that can scarce sit in a Saddle for the Pox! But it may be he had a great Estate.

Ga. He had once an indifferent one; but by his living so fast, has little or nothing left, but one little Turret, from whence he makes Incursions to rob Passengers; and that's so illy pro-

vided for Entertainment, that you would not accept of it for a Hog-Stye. And he's always bragging of his Castles, and Fiefs, and other great Things; and is for setting up his Coat of Arms everywhere.

Pet. What Coat of Arms does his Shield bear?

Ga. Three Golden Elephants in a Field Gules.

Pet. Indeed an Elephant is a good Bearing for one that is sick of the Elephantiasis. He must, without Doubt, be a Man of Blood.

Ga. Rather a Man of Wine; for he is a great Admirer of Red Wine, and by this Means he is a Man of Blood for you.

Pet. Well then, his Elephant's Trunk will be serviceable to him.

Ga. It will so.

Pet. Then this Coat of Arms is a Token that he is a great Knave, a Fool, and a Drunken Sot; and the Field of his Coat of Armour represents Wine, and not Blood; and the Golden Elephant denotes, that what Gold he had, has been spent in Wine.

Ga. Very right.

Pet. Well, what Jointure does this Bully settle upon his Bride?

Ga. What? Why a very great one.

Pet. How can a Bankrupt settle a large one?

Ga. Pray don't take me up so short; I say again, a very large one, a thundering Pox.

Pet. Hange me, if I would not sooner marry my Daughter to a Horse, than to such a knight as he.

Ga. I should abundantly rather chuse to marry my Daughter to a Monk; for this is not marrying to a Man, but to the Carcase of a Man. Now, tell me, had you been present where this Spectacle was to be seen, could you refrain from Tears?

Pet. How should I, when I can't hear it without? Were the Parents so abandoned to all natural Affection, as to

throw away their only Child, a Virgin of such Beauty, Accomplishments, and sweet Conditions, by selling her for a Slave to such a Monster, for a lying Coat of Arms?

Ga. But this enormous Crime, than which you can't find one more inhuman, cruel or unlike a Parent, is made but a Jest on now-a-days by our People of Quality: altho' it is necessary that those that are born for the Administration of the Affairs of the Government, should be Persons of very sound and strong Constitutions: For the Constitution of the Body has a great Influence upon the Mind; and it is not to be doubted, but this Disease exhausts all the Brains a Man has: and by this Means it comes to pass, that our Ministers of State have neither sound Minds, nor sound Bodies.

Pet. It is only requisite that our Ministers of State should be Men of sound Judgment, and strong Constitutions but Men of Honour, and goodly Personages. Altho' the principal Qualifications of Princes are Wisdom and Integrity, yet it is of some considerable Moment what the Form of his Person is that governs others: for if he be cruel, the Deformity of his Body will expose him the more to Envy. If he be a Prince of Probity and Piety, his Virtue will be render'd more conspicuous by the Amiableness of his Person.

Ga. That's very true.

Pet. Don't People use to lament the Misfortune of those Women, whose Husbands, soon after their Marriage, fall into Leprosies or Apoplexies?

Ga. Yes, and that with very good Reason too.

Pet. What Madness is it then, voluntarily to deliver a Daughter over into the Hands of a Leper?

Ga. Nay, it is worse than Madness. If a Nobleman has a Mind to have a good Pack of Hounds, do you think he

would bring a mangy scoundrel Cur to a well-bred Bitch?

Pet. No, he would with the utmost Diligence look for a Dog, that upon all Accounts was of a good Breed, to line her, that he might not have a Litter of Mongrels.

Ga. And if a Lord has a Mind to have a good Breed of Horses, would he admit a diseased good-for-nothing Stallion to leap a most excellent Mare?

Pet. No, he would not suffer a diseased Stallion to enter his Stable Door, lest he should infect other Horses.

Ga. And yet, at the same Time, they don't matter what Sort of a Son-in-Law they gave their Daughter to, from whom those Children are to be produc'd, that are not only to inherit their Estates, but also to govern the State.

Pet. Nay, a Country Farmer won't suffer any Bull to leap a young Cow, nor every Horse his Mare, nor every Boar to brim his Sow; tho' a Bullock is design'd for the Plough, a Horse for the Cart, and a Swine for the Kitchen.

Ga. See now how perverse the Judgments of Mankind are. If a poor Fellow should presume to kiss a Nobleman's Daughter, they would think the Affront a Foundation enough to go to War upon.

Pet. And very hotly too.

Ga. And yet these Persons, voluntarily, knowingly, and deliberately, give up the dearest Thing they have in the World to such an abominable Monster, and are privately unnatural to their own Flesh and Blood, and publickly to their Country.

Pet. If the Bridegroom does but halt a little, altho' as to any Thing else he is perfectly sound, how is he despis'd for a Husband! And is the Pox the only Thing that is no Inconvenience to a married Life?

Ga. If any Man should marry his Daughter to a *Franciscan*, what an abominable Thing would it be accounted! what an Outcry would there be, that he had

thrown his Daughter away! But yet, when he has pull'd off that Dress, he has every Way well-made sound Limbs; while the other must pass her Days with a rotten Carcase, that is but half alive. If any one is married to a Priest, he is banter'd on account of his Uncution; but one that is married to one that has the Pox, has one whose Uncutions are worse by Abundance.

Pet. Enemies that have taken a Maid captive, won't be guilty of such Barbarity as this; nor will Kidnappers themselves, to those they have kidnapped away; and yet Parents will be guilty of it against their only Daughter; and there's no Magistrate ordain'd to prevent the Mischief.

Ga. How should a Physician cure a Madman, if he has a Spice of the same Distemper himself?

Pet. But it is a Wonder to me, that Princes, whose Business it is to take Care of the Common-Wealth only in those Things which relate to the Body, of which nothing is of greater Moment than the Health of it, should find out no Remedy for this Evil. This egregious Pestilence has infected great Part of the Earth; and in the mean Time they lie snoring on, and never mind it, as if it were a Matter not worth their Notice.

Ga. Have a Care, Petronius, what you say as to Princes. But hark you, I'll tell you a Word in your Ear.

Pet. O wretched! I wish what you say were not true.

Ga. How many Disease do you think are caused by bad Wine, a thousand Ways sophisticated?

Pet. Why, if we may believe the Physicians, they are innumerable.

Ga. Well, and do the Ministers of State take any Care of the Matter?

Pet. They take Care enough as to the collecting the Excise, but no further.

Ga. She that knowingly marries a Husband that is not sound, perhaps may deserve to suffer the Punishment she has

- brought upon herself; altho', if it were my Fortune to sit at the Helm, I would banish them both from civil Society: But if any one married one that was infected with this Disease, who told her he was a sound Man, and I were chosen Pope, I would make this Marriage void, altho' it had been confirmed by a thousand Contracts.
- Pet. Upon what Pretence I wonder? For Marriage legally contracted can't be disannull'd by any human Power.
- Ga. What? Do you think that legally contracted, which is contracted treacherously? A Contract is not valid, if a Slave palms himself upon a Maid for a free Man, and she marries him as such. She that marries such a Slave, marries an errant Slave; and her Slavery is so much the more unhappy, in that the Lady *Psora* never makes any Body free; that there's no comfortable Hope of ever being deliver'd from this Slavery.
- Pet. Indeed you have found out a Colour of it.
- Ga. And besides, there can be no such Thing as Marriage, but between those Persons who are living; but in this Case, a Woman is married to a dead Man.
- Pet. You have found out another Pretence: But I suppose you would permit pocky Folks to marry pocky, that, according to the old Proverb, there might be *like to like*.
- Ga. If it was lawful for me to act for the Good of the Public, I would suffer them to be married together, but I would burn them after they were married.
- Pet. Then you would act the Part of a Tyrant, not of a Prince.
- Ga. Do you account a Surgeon to be a Tyrant who cuts off some of the Fingers, or burns some Part to preserve the whole Body? I don't look upon that to be Cruelty, but rather Mercy. And I wish this had been done when this Distemper first appear'd in the World; then the publick Welfare of Mankind had been consulted by the Destruction of a few. And we find Examples of this in the *French Histories*.
- Pet. But it would be a gentler Way to geld them, or part them asunder.
- Ga. And what would you have done to the Women, pray?
- Pet. I'd padlock them up.
- Ga. That's one Way, indeed, to prevent us from having more of the Breed; but I will confess it is a gentler Way, if you will but own the other to be safer. Even those that are castrated, have an itching Desire upon them; nor is the Infection convey'd by one Way only, but by a Kiss, by Discourse, by a Touch, or by drinking with an infected Party. And we find also, that there is a certain malicious Disposition of doing Mischief peculiar to this Distemper, that whosoever has it, takes a Delight to propagate it to as many as he can, tho' it does him no good. Now if they be only separated, they may flee to other places, and may either by Night impose upon Persons, or on them that do not know them. But there can be no Danger from the Dead.
- Pet. I confess it is the safest Way, but I can't tell whether it is agreeable to Christian Gentleness or no.
- Ga. Prithee tell me then, from whom is there the most Danger, from common Thieves, or from such Cattle?
- Pet. I confess Money is of much less Value than Health.
- Ga. And yet we Christians hang them, nor is it accounted Cruelty, but Justice; and if you consider the publick Good, it is our Duty so to do.
- Pet. But in this Case, the Person is punish'd that did the Injury.
- Ga. What, then these, I warrant you, are Benefactors to the Publick? But let us suppose that some get this Distemper without any Fault of their own; tho' you will find that very few have it,

that don't get it by their own Wickedness: the Lawyers will tell you, it is sometimes lawful to put the Innocent to Death, if it be very much for the Good of the Publick; as the *Greeks*, after the taking of *Troy*, put *Astyanax*, the Son of *Hector*, to Death lest he should set a new War on Foot: Nor do they think it any Wickedness, to put a Tyrant's innocent Children to Death, after they have slain the Father. And do not we Christians go to War, tho' at the same Time the greatest Share of the Calamities falls on those Persons, that least deserve them? And it is the same Thing in our Reprisals, or Letters of Mark; he who did the Wrong is safe, and the Merchant is robb'd, who never so much as heard one Word of it, he is so far from being chargeable with the Fault. Now if we make Use of such Remedies as these in Things of no great Moment, what, think you, ought to be done in a Matter of greatest Consequence.

Pet. I am overcome by the Truth of your Arguments.

Ga. Then take this along with you too. As soon as ever the Plague begins to appear in *Italy*, the infected Houses are shut up, and the Nurses that look after the Sick, are forbidden to appear abroad. And tho' some call this Inhumanity, it is the greatest Humanity; for by this prudent Care, the Calamity is put a Stop to, by the Burials of a few Persons. But how great Humanity is it to take Care to preserve the Lives of so many thousands? Some think it a very inhospitable Thing for the *Italians*, when there is but the bare Report of a Pestilence, to drive travellers from their very Gates in an Evening, and force them to lie all night in the open Air. But for my Part, I account it an Act of Piety to take Care of the publick Good at the Inconvenience of a few. Some Persons look upon themselves very courageous and complaisant, in daring to venture

to visit one that is sick of the Plague, having no Manner of Call at all to do it; but what greater Folly can there be, than by this Courage, when they come Home, to bring the Distemper to their Wives and Children, and all their Family? What can be more unkind, than by this Complaisance to a Friend, to bring those Persons that are the dearest to you in the World, into the Danger of their Lives? But then again, how less dangerous is the Plague itself than the Pox? The Plague frequently passes by those that are nearest, and seldom affects the old; and as to those that it does affect, it either dispatches them quickly, or restores them to their Health much sounder than they were before. But as for the Pox, what is that but a lingering Death; or, to speak more properly, Burial?

Pet. What you say is very true; and at least, the same Care ought to be taken to prevent so fatal an Evil, as they take to prevent the spreading of the Leprosy, or if this should be thought too much, no Body should let another shave him, but be his own Barber.

Ga. But what will you say, if both of them keep their Mouths shut?

Pet. They would take the Infection in at their Nostrils.

Ga. But there is a Remedy for that too.

Pet. What is it?

Ga. They may do as the Alchymists do, they may wear a Mask with Glasses for Eyes to see thro', and a breathing Place for their Mouths and Nostrils, thro' a Horn which reaches from their Jaw-Bones down to their Back.

Pet. That Contrivance might do pretty well, if there were no Danger from the Touch of the Finger, the Linen, the Combs and the Scissars.

Ga. But however, I think 'tis the best Way to let the Beard grow, tho' it be even down to the Knees.

Pet. Why, I am of that Mind too. And then let there be an Act of Parliament,

that the same Person shan't be a Barber and a Surgeon too.

Ga. But that's the Way to starve the Barbers.

Pet. Then let them spend less, and be something better paid for Shaving.

Ga. Let it be so with all my Heart.

Pet. And let there be a Law made too, that no Body shall drink out of the same Cup with another.

Ga. They will scarce be confin'd to that in England.

Pet. And that two shan't lie in the same Bed, unless they be Husband and Wife.

Ga. I like that very well.

Pet. And then as to Inns, let no Stranger sleep in the same Sheets that another has lain in before.

Ga. But what will you do then with the Germans, who scarce wash them twice a Year?

Pet. Let them employ Washer-Women. And besides, let them leave off the Custom of saluting with a Kiss, altho' it be of an old standing.

Ga. But then, as to the Churches?

Pet. Let every one hold his Hand before his Mouth.

Ga. But then as to common Conversation.

Pet. Let that Direction of *Homer* be observed, not to come too near the Person he talks to, and let he that hears him keep his Lips shut.

Ga. Twelve Tables would scarce contain all these Laws.

Pet. But in the mean Time, what Advice do you give for the poor unfortunate Girl?

Ga. What can I give her but this, that unless she likes being miserable, she be so as little as she can? to clap her Hands before her Mouth, whenever her Husband offers to kiss her; and to put on Armour when she goes to Bed with him.

Pet. Whither do you steer your Course when you go Home?

Ga. Directly to my Closet.

Pet. What are you going to do there?

Ga. They have desired me to write an *Epitbalamium*; but instead of it, I will write an Epitaph.

Desiderius Erasmus was born at Rotterdam in Holland, on October 20th or 28th, in 1465, according to his Epitaph at Basil. His mother's name was Margaret, the daughter of one Peter, a physician of Sevenbergen. His father's name was Gerard.

Erasmus was born out of wedlock, and on that account Father Theophilus Raynaud has this pleasant passage concerning him: "If one be allowed to droll upon a man that droll'd upon the whole world, Erasmus, tho he was not the son of a King, yet he was the son of a crown'd head" (meaning a priest). But in this he appears to have been mistaken, in that the father was not in orders when he begat him.

Gerard was one of ten, himself the last. According to the superstition of the times, being the tenth child, the old people had a mind to consecrate him to God. Erasmus was after his father named Gerard, which in the German tongue signifies amiable. In those times it was the custom of learned men to affect their names in Latin or Greek. It was turned to Desiderius in Latin and Erasmus in Greek.

Erasmus was placed in school when four years of age. He was a Chorister at Utrecht until he was nine years old, and then was sent to Daventer to be instructed by the famous Alexander Hegius, a Westphalian. Erasmus was a remarkable student; his memory enabling him to recite Terence and Horace in entirety.

In his thirteenth year his mother died of the plague at that time sweeping the country. Soon after his father died of melancholy over the death of his wife. Neither parent was much over forty.

Erasmus had three guardians; and, although there was an ample fortune for his support and he was fit for the university, they designed him for a monastic life, removing him to Bois-le-Duc, where, he says, he lost three years living in a Franciscan convent. Suffering from a quartan ague he was obliged to return home.

By threats and flattery his guardians prevailed upon him to enter a monastery, but finding him not to be moved, they gave him up. Young Erasmus decided that he was old enough to take care of himself.

By accident Erasmus encountered Cornelius, a schoolmate at Davenport, and Cornelius induced him to enter the religious life, which offered the advantages of libraries, of learned men, and the freedom of distractions of the outer world. All of it fell short of his expectations, but, after a year of probation, he found himself with no alternative and became a member of their fraternity.

Erasmus was taken into the family of Henry à Bergis, Bishop of Cambray, and here his knowledge of Latin was useful. Later he was sent to the University of Paris; afterwards admitted to Montague College, when illness obliged him to return to the Bishop. His health restored, he made a journey to Holland, intending to settle there, but was persuaded to go a second time to Paris, where, having no patron to support him, he himself says, he rather made a shift to live than could be said to study.

He visited England, where he was received with great respect, and he honored it next to the place of his nativity. He passed some years at Cambridge; and he was particularly acquainted with Sir Thomas More, Colet, Dean of St. Paul, Grocinus, Linacer, Latimer, and many others of the most eminent of that time.

He again returned to France, but not meeting with the preferment he expected, he made a voyage to Italy. He took his Doctor of Divinity degree at the University of Turin; stayed about a year in Bologna; afterwards went to Venice, and there published his Book of Adages from the press of the famous Aldus. From there he went to Padua, and last to Rome, where his fame had arrived long before him. Here he gained the friendship and goodwill of all the influential men of the city and could not have failed to make his fortune. However he was prevailed upon by friends to return to England on Henry the Eighth coming to the crown. He was taken into favor by Warham, Archbishop of Canterbury, who gave him the living of Aldington in Kent. Again there were disappointments, probably because of the continual clashes between Warham and Wolsey, and Erasmus went to Flanders. Through Chancellor Sylvagius, he was made counsellor to Charles of Austria, later Charles v, Emperor of Germany.

Erasmus resided several years at Basel, but when the mass was abolished in that city by the Reformation, he retired to Friberg in Alsace, where he lived seven years. Having been afflicted with the gout for a long time, he left Friberg and returned to Basel. Here the gout soon left him, but he contracted dysentery and, after an illness of a month, died of that disease on the 22nd of July, 1536, in the house of Jerome Frobenius, son of John, the famous printer.





## BOOK REVIEWS

**PRACTICAL PROCTOLOGY.** By Louis A. Buie, M.D., F.A.C.S. Philadelphia, 1937. W. B. Saunders Company. Price \$6.50.

If either the medical student, practitioner, or surgeon desires a fairly small (512 pages, 151 illustrations), direct book on proctology, we would be neglecting our duty as a reviewer not to tell him that Dr. Buie has written such a volume. Dr. Buie for many years has been associated with the Mayo Clinic, and has had to do with the diagnosis and the medical and surgical management of diseases of the anus, rectum and colon. As Dr. Charles H. Mayo says in a short foreword, "Dr. Buie in this book has presented the old and the new in a most interesting and fascinating as well as practical manner." In a few words, this is an excellent review of the work we are discussing.

In every respect the work is truly practical. The subject is thoroughly covered, a bibliography is appended at the conclusion of each chapter, the illustrations are of a high order, and the index ample. Although etiology is covered with other basic scientific facts, what caught our attention was the amount of space devoted to what to do for the patient after a diagnosis has been made. How to make a diagnosis, however, is not neglected.

This is the sort of book one enjoys reading; one will refer to it many times in the course of his daily work. The publisher has given us a well written book, on good paper, with type easily read, and general make-up pleasing in every way. Decidedly a practical work, it will be welcomed by those who wish for a book on proctology as their guide in the practice of medicine.

**INTRODUCTION TO OPHTHALMOLOGY.** By Peter C. Kronfeld, M.D. Springfield, 1938. Charles C. Thomas. Price \$3.50.

This book (331 pages) is a splendid work for the student as a prelude to the more formal, detailed and involved textbooks. Dr. Kronfeld, Professor of Ophthalmology at the Peiping Union Medical College, has endeavored (and successfully) to formulate the principles underlying that portion of ophthalmology which is a necessary part of basic medical education. The subject matter offered pertains principally to

the pathogenesis of disease. The author has purposely omitted the details of diagnosis and the methods of examination. He discusses individual diseases to illustrate pathogenetic principles. Also, with intent, he has omitted a consideration of a large number of common diseases. Of these the reader will find a short description in the dictionary which is combined with the index of this book. References are listed at the end of each chapter.

The book is beautifully written. The publisher, as usual, has given us a book well nigh perfect typographically.

To those who want a book leading to the extended study of this subject this introduction is suggested.

**THE TREATMENT OF CLINICAL AND LABORATORY DATA. AN INTRODUCTION TO STATISTICAL IDEAS AND METHODS FOR MEDICAL AND DENTAL WORKERS.** By Donald Mainland, M.B., CH.B., D.SC. Edinburgh and London, 1938. Oliver and Boyd. Price 15 shillings.

We hope the majority of medical writers will own and carefully study this book (340 pages), written by the Professor of Anatomy at Dalhousie University. This statement is especially directed to those who offer statistical reports of the results of their laboratory and clinical researches. Donald Mainland has outlined here the treatment of clinical and laboratory data in such manner that our medical literature in the future should be the better for his teaching.

After the introduction (covering such topics as Neglect of Chance and Sampling Errors, Mathematical and "Commonsense" Methods, Method of Study), the chapter headings are: General Principles and the Estimation of Odds, The Comparison of Samples of Material Classified Qualitatively, Data Based on Measurements, Errors in Measurement, Correlation and Curve Fitting, Publication of Data and Results, and Supplementary Notes.

There are four pages of references, 23 text figures, and an index.

This is a subject most physicians know nothing about, but of which, in the present day trend to summarize end results and findings in statistical formulas, curves and charts, they

could afford to know a great deal. The book is one which medical authors should have near at hand.

**MACLEOD'S PHYSIOLOGY IN MODERN MEDICINE.** Edited by Philip Bard. Eighth Edition. St. Louis, 1938. C. V. Mosby Company. Price \$8.50.

J. J. R. Macleod first brought this work out in 1918. He survived to bring out five more editions, but in 1935, just prior to the publication of the seventh edition, he died. When it was deemed necessary to bring out an eighth (the present) edition, Philip Bard, Professor of Physiology, at the Johns Hopkins University School of Medicine, was selected as eminently fitted for the task. He then invited a number of investigators to take part in the enterprise, and the volume is composed of the contributions of nine individuals (Henry C. Bazett, George R. Cowgill, Harry Eagle, Chalmers L. Gemmill, Magnus I. Gregersen, Roy G. Hoskins, J. M. D. Olmsted, and Carl F. Schmidt). Little of the seventh edition remains: the greater part of the work has been entirely rewritten.

The prefaces of the earlier editions stated that the purpose of the book was "to serve as a guide to the clinical application of physiology and biochemistry"; later (the fifth edition), the book was extended "in order that it may also be used as a textbook of physiology for students of medicine," and finally care was taken "to bring up to date those parts of the subject for which no application may be evident." This trend has been continued in the present edition.

This volume (1051 pages) is well illustrated, with ample references and an index, and may well serve as a textbook not only to medical students, but to those practicing medicine who desire to get up to date on physiology in modern medicine.

**A TEXT-BOOK OF OPHTHALMIC OPERATIONS.** By Harold Grimsdale, M.B., F.R.C.S., and Elmore Brewerton, F.R.C.S. Third Edition. Baltimore, 1937. William Wood & Co. Price \$6.00.

This book has stood the test of time and is known to those who limit their work to surgery of the eye. Therefore, many will welcome a third edition.

In the preface to this new edition, the authors state: "It has been suggested to us that we

have in the past dealt too much with historical operations. In the present edition we have excised much that had interest only in the development of operative surgery, and have tried, by leaving out unessential matter, to make a book more helpful to the student of ophthalmology." They have lived up well to this blueprint.

This book (322 pages) has 105 figures, a list of authorities at the conclusion of each chapter, and an ample index.

**THE SCIENCE AND PRACTICE OF SURGERY.** By W. H. C. Romanis, M.B., M.CH., F.R.C.S., F.R.S., and Philip H. Mitchiner, M.D., M.S., F.R.C.S. Sixth Edition. London, 1937. J. & A. Churchill, Ltd. 2 Volumes. Price 28 shillings.

The first edition of this two volume surgery appeared in 1927. Every year or two a new edition has appeared and now we are offered it in its sixth edition. Any work that reaches a sixth edition in ten years time needs no praise: this alone speaks for its worth and popularity.

In this edition a section has been added on the medical aspects of "gas," and the chapters on fractures and dislocations have been largely rewritten. The chapter on x-rays and ray therapy has been revised and brought up to date. The section on the sympathetic nervous system has been rewritten and enlarged. A number of new illustrations and plates have been included.

This book was written primarily for students, but the authors feel, and we readily concur, that this work will also prove valuable to those reading for higher surgical qualifications, as well as for the medical practitioner.

**PRIMARY CARCINOMA OF THE LUNG.** By Edwin J. Simons, M.D. Chicago, 1937. The Year Book Publishers, Inc. Price \$5.00.

The author tells us in his preface that Dr. Evarts A. Graham had accepted his work for serial publication in the *Journal of Thoracic Surgery*, but found that continual lack of space for such an extended contribution made publication in book form more practical.

The study represents the composite efforts of many persons. The book covers: historical aspects, incidence, etiology, pathology, clinical considerations, and treatment of lung cancer with summary and conclusions at the end.

There is an ample bibliography, an index, and 30 figures, some in color.

This book of 263 pages is well written, scientifically sound (the chapter on treatment is alone worth the price of the book), and we recommend it to both internist and surgeon.

A MONOGRAPH ON VEINS. By Kenneth J. Franklin, D.M., M.R.C.P. Springfield, 1937. Charles C. Thomas. Price \$6.00.

This is a book one cannot adequately review. Suffice it to state at the start that anyone interested in this subject, either from a surgical or medical viewpoint, will find this book invaluable. We are informed that only two other writers, Professor Klothilde Gollwitzer-Meier (1932) and M. L. Waterman (1933), have previously produced at all comprehensive and detailed works on the veins. In 1913, Professor J. A. Gunn, in conjunction with F. B. Chavasse, published a paper on the pharmacology of isolated veins. In 1924, he suggested to Dr. Franklin, that he continue the work. As a result the latter spent several years in research upon the venous system, and the present volume thus developed. In order to make available a somewhat recondite literature, which only a specialist could hope to summarize but which has, nevertheless, very definite bearings upon physiologic, pathologic, and clinical problems, this book was written.

The reading matter covers 350 pages, and there are forty-six illustrations. The bibliography is sixty pages long, but there is no index. Well written, and to the point, this book covers a subject of wide interest to most physicians.

APPROVED LABORATORY TECHNIC. CLINICAL, PATHOLOGICAL, BACTERIOLOGICAL,

MYCOLOGICAL, PARASITOLOGICAL, SEROLOGICAL, BIOCHEMICAL AND HISTOLOGICAL. By John A. Kolmer, M.D., and Fred Boerner, V.M.D. Second Edition. New York, 1938. D. Appleton-Century Company.

The first edition of this book appeared in 1931 and the work received a generous reception from medical students, physicians, teachers, clinical pathologists and laboratory technicians. In the first edition, the techniques and methods given were approved by committees selected from members of the American Society of Clinical Pathologists. In this edition they have been approved by members of a group of twenty-eight collaborators as well as, in many instances, by the authors of the methods themselves.

Each chapter has been thoroughly revised and the majority rewritten. During the past few years many new methods have been developed and added to the facilities of the clinical laboratory. The authors have selected those of approved value. Five new chapters have been added. Special emphasis has been placed on parasitology and added space given to mycology. Dr. A. V. St. George rewrote the chapter on Methods for Toxicological Examinations, in view of their importance in relation to medicolegal practice.

The text is especially well written (893 pages); there are twelve plates, 380 illustrations, and an index.

We feel that this book is sound and scientifically the last word. We may be prejudiced, however, for some years back, wishing to reward a young physician, we looked over the field and selected the first edition of this work, which we gave him as a present. Had we to repeat history, we would, again, select this, the second edition.

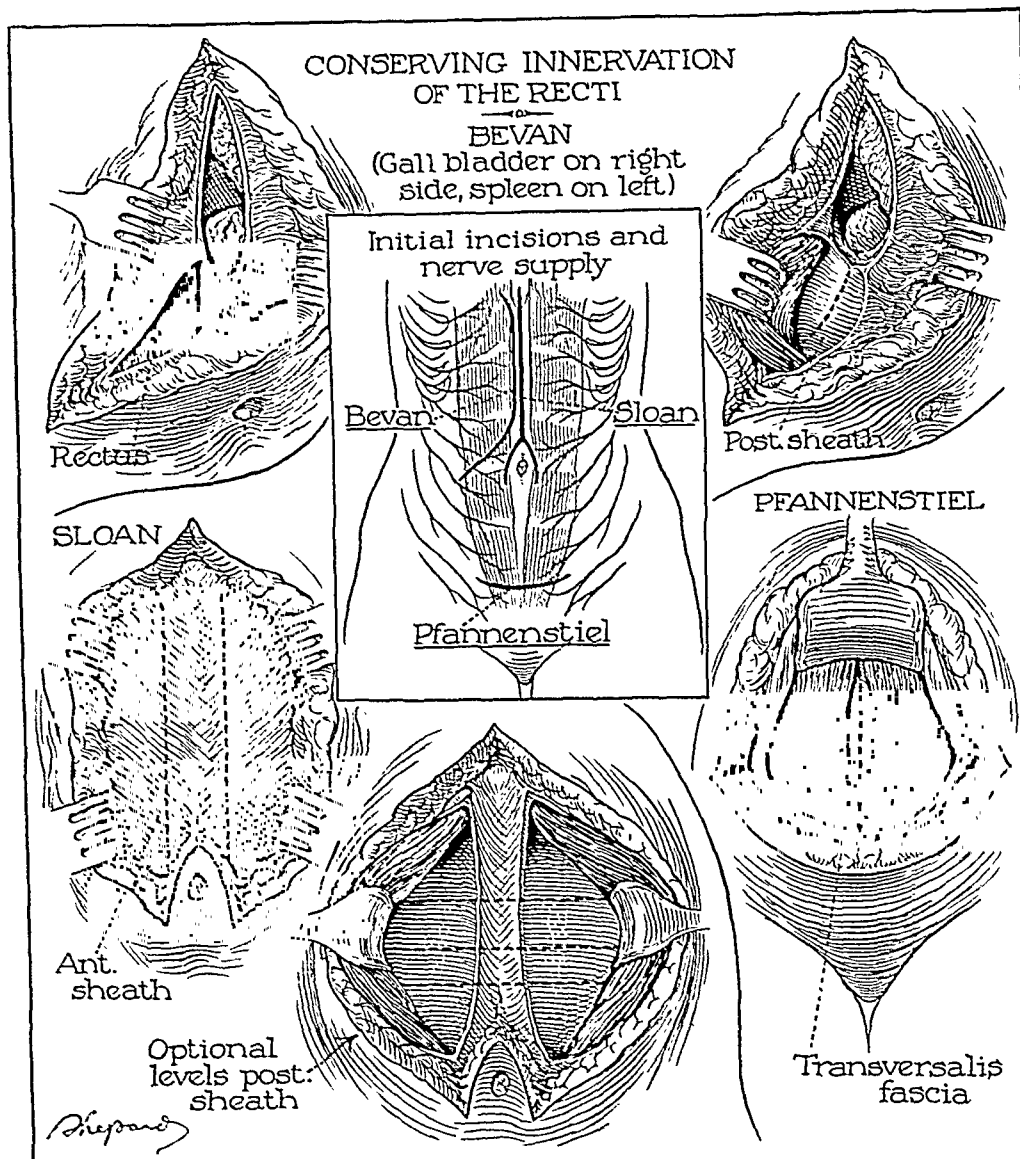


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# OPERATIVE PROCEDURE

PLATE NO. 82

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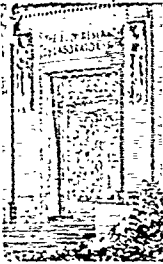
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# ORIGINAL ARTICLES

## INTESTINAL OBSTRUCTION\*

AN ANALYSIS OF 200 CASES ATTEMPTING IMPROVED CORRELATION OF MORTALITY, PATHOLOGIC PHYSIOLOGY, AND SIGNS AND SYMPTOMS

J. K. DONALDSON, M.D.

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LITTLE ROCK, ARKANSAS

IN a recent discussion of intestinal obstruction the author stressed various morbid processes of the disease as they occur in different conditions ordinarily listed under the intestinal obstruction heading, and presented a simplified classification based upon pathologic physiology.<sup>1</sup> The chief efforts made in this present article are to analyze mortality rates and signs and symptoms in different types of obstruction, and to appreciate more fully the distinction between *early* and *late* signs as they are interpreted in the light of previously discussed pathologic fundamentals.<sup>1</sup>

In many textbooks of surgery one finds numerous diagnostic signs and symptoms listed, with insufficient stress on the fact that many of these may frequently occur only at advanced stages in the morbid process, and that they are somewhat variable in different types of obstructions. McIver, in 1933, in speaking of morbid processes occurring in different types stressed the fact that they are often at wide variance with each other: "This lack of uniformity in clinical picture, etiology and pathology creates a situation which is complicated and lends itself to misunderstanding and confusion, more especially since in spite of its very broad meaning the term intestinal obstruction is often used as though it represented a single clear-cut entity."<sup>4</sup>

Of course it is impractical for brief surgical texts to attempt undue detail. Nevertheless, those relying upon textbook descriptions of intestinal obstruction should appreciate their limitations, since inadequate criteria may become dangerous. This would seem true, for example, concerning distention. Nearly all the texts describe or allow the assumption that distention is an early part of the picture of obstruction when actually it may not be at all. The following are excerpts from popular books. "Distention from gas (tympanites) is always soon present." "Distention of the abdomen usually occurs—." Another speaks of "gaseous distention of the bowel, without abdominal rigidity," and again, "meteorism—gaseous distention of the intestine—" without any correlation with pathologic stages.

However, statistics show that even in simple obstructions the mortality is very high if one waits more than forty-eight hours from the onset of obstruction to institute proper treatment, not to speak of the necessity for still earlier treatment in gangrenous and folded loop cases. It is therefore easy to see why it behooves us to know just what signs and symptoms we may depend upon to diagnose a given case in a truly early stage.

Because of inadequate detail in the charts studied, only fifty-one of the two hundred reviewed were incorporated for

\* From the Department of Surgery, University of Arkansas Medical School, Little Rock, Arkansas.

final analysis, and deficiencies are present in some of these.\* We were able, however, to designate with a satisfactory degree of accuracy distention as it occurred in twelve-hour period groups as measured from time of onset in a number of cases. Deep seated tenderness, constipation, pain and vomiting were noted fairly consistently. No other signs or symptoms were found to be or considered as of definite importance for the purpose of this analysis, though in so far as was possible an attempt was made to list them. X-ray findings were not incorporated.

#### MORTALITY IN DIFFERENT TYPES AND RELATIONSHIP OF THE TIME FACTOR†

No effort will be made here to review in detail all the facts in the tables, but a number of findings warrant comment:

The total mortality for all the cases in the tables was 58.8 per cent. That the folded loop obstructions are more serious than the simple ones is illustrated in that the mortality for the former was approximately 12 per cent higher (71.4 per cent) than the latter (59 per cent) despite the fact that cases with folded loop obstructions were operated on approximately twenty-two hours earlier from onset (average 37.45 hours) than the simple ones (average 59.5 hours). When even simple obstructions went over forty-eight hours from onset without proper treatment the mortality rate was very high (84.6 per cent); and when over seventy-two hours the mortality was 100 per cent. When operation was done at or under forty-eight hours (average 32 hours) in this series the mortality was 12.5 per cent.

A mortality rate below the average for obstructions was present with obstructing hernias (27.2 per cent). This was probably due to the previous education of the

patient, the earlier diagnosis and earlier operation (average 30 hours).

The 100 per cent mortality in the two cases of mesenteric thrombosis and the 50 per cent mortality in the three intussusception cases are roughly comparable with mortality statistics of others.

The seriousness of cases with gangrene was demonstrated by a 100 per cent mortality, a figure higher than in some other series. Only one patient with gangrene was operated on within twelve hours from onset and he died. One may evidently assume that we must operate on such patients within twelve hours if a reasonably low mortality is to be obtained. Absorption of toxin probably begins within thirty minutes after arterial blood supply is completely blocked.<sup>3</sup>

#### SIGNS AND SYMPTOMS IN DIFFERENT TYPES: FREQUENCY AND TIME OF DEVELOPMENT

Table v was compiled in such a way that I believe it to be a reasonably accurate index to the time in which *distention* occurs in different types. In the simple obstructions, in no instance was distention definitely noted in the first twenty-four hours. It was definitely observed that it was not present in seven and four of these cases in the first and second twelve-hour periods respectively. In the third twelve-hour period, up to and including the thirty-sixth hour, the chances as calculated here seem four to one that clinical distention of note will not be present in simple obstructions. The writer would not be justified in stipulating that in the fourth twelve-hour period, simple obstruction would present clinical distention in only 50 per cent of the cases, as is indicated in this series; but he can say definitely that he has seen many cases which did not present clinical distention in this length of time, and this 50 per cent figure would seem reasonably accurate. After forty-eight hours nearly all cases of simple obstruction will present clinical distention, but it may not be marked in some in the earlier part of the fifth twelve-hour period.

\* The case records were obtained from the Little Rock General Hospital and St. Vincent's Infirmary. The writer wishes to acknowledge the courtesy of Sister Teresa, Mrs. Loula R. Ashbaugh and Miss Helen Robinson in collection of the histories.

† Cases in which operation was markedly delayed were excluded in calculation of the following averages.

TABLE I  
SIMPLE OBSTRUCTIONS

Case Number	No. Hrs. before Operated	Distention	Vomiting	Gangrene	Remarks	Result
132335	7 days	3 days	?	No	No B.M. 7 days	Died
18548	6 days	Eventually	Early	No	Probably partial ob- stipation for a time.	Died
233735	4 days (?)	At 3 days (?)	Early	No	No B.M.	Died
18971	Died fourth day without surgery	?	?	?	No B.M.	Died
18582	Not operated. Died after fourth day	At 3 days	Within 1 hr.	No	No undue rigidity but tense. One B.M. since onset. No masses.	Died
1321	96 hrs.	Slight at 48	3 hrs.	No	Slight rigidity and moderate tender- ness. Visible per- istalsis at 48 hrs.	Died
23234	90 hrs.	Marked at 90	?	?	Small B.M. twice after onset. No masses.	Died
19438	84 hrs.	84 hrs.	Yes	?	Tender and tense at 84.	Died
23161	80 hrs.	None at 12 hrs. Some at 48 hrs. Definite at 72 hrs.	None at 24 hrs. Once at 48 hrs.	No	Enema slight re- sults once. No rigidity 12 hrs. Moderate diffuse at 12 hrs. Ab- domen silent at 12.	Died
1670	72 hrs.	72 hrs.	Onset	No	Tender at 72 hrs. No definite rigid- idity.	Died
1504	70 hrs.	"Somewhat" at 48	?	No	Slight tenderness at 48 hrs. No masses.	Died
19438	50 hrs.	Marked at 50 hrs.	At onset	No	Rigidity definite at 50 hrs. No B.M.	Died
24060	40 hrs.	At 36 hrs.	?	No	No B.M. Enema no results.	Died
251935	70 hrs.	At 36 hrs.	Early	No	Slight B.M. nausea and successful duo- denal drainage 36 hrs.	Lived
21916	50 hrs.	No distention at 18 hrs.	6½ hrs.	No	Some general ten- derness and local rigidity at 18 hrs.	Lived



TABLE I (Continued)

Case Number	No. Hrs. before Operated	Distention	Vomiting	Gangrene	Remarks	Result
102535	48 hrs. ?	?	Continuous	No	No B.M. Enema results.	Lived
126635	48 hrs.	?	None at 10 hrs.	No	.....	Lived
4141	48 hrs.	No distention clinically but marked at table.	?	Dark splotches present on gut.	No B.M.	Lived
23406	36 hrs.	Not marked at 36 hrs.	Moderately early	No	.....	Lived
22594	At 18 hrs.	"Moderate" tympany at 18 hrs. Enema clear	In 4-5 hrs.	No	.....	Lived
65035	10 hrs.	None at 10 hrs.	None at 10 hrs.	No	.....	Lived
260136	6 to 10 hrs.	None	Apparently not	No	.....	Lived

Average time operated from onset excluding abnormally delayed cases—59.5 hrs.

Total died.....	13
Total lived.....	9
Mortality.....	59 per cent

It should be said that when distention of the abdomen is not present at inspection, the coils of intestine at the operating table may, nevertheless, possibly be found distended, to the extent that toxin absorption is evidently occurring. One may appreciate the importance of fully realizing that distention actually is a late sign by correlating the time of occurrence of distention with the mortality statistics which are presented here and elsewhere. Since distention in simple obstructions does not seem to occur with any great degree of consistency until the fourth twelve-hour period, and since it has been repeatedly demonstrated that the mortality is unduly high unless relief is given before forty-eight hours have passed, *we must consider distention as usually a late sign.*

Table v shows that distention in folded loop obstructions in this series seemed to come earlier than it did in simple obstructions. Correlating this with the time and mortality factor as listed in Table II, one

may see that in folded loop obstructions lethal factors function earlier and more rapidly than in simple ones. Therefore, distention, though coming within a few hours from onset of obstruction, nevertheless may appear only late in the morbid picture; and again one should surely not depend upon it as an early diagnostic sign.

It is seen that distention in strangulated hernias would seem to occur about as in simple obstructions. Proper interpretation of the pathologic physiology of this type of obstruction would lead one to expect this.

In mesenteric thrombosis, intussusception and other conditions in which gangrene is present, one surely must not wait for distention to develop, since gangrenous tissue predestines death within a very few hours.

Perusal of the tables demonstrates the fact that vomiting is a fairly constant symptom, occurring early in the majority

TABLE II  
FOLDED LOOP OBSTRUCTIONS

Case Number	No. Hrs. before Operated	Distention	Vomiting	Gangrene	Remarks	Result
3037	6 days	?	Yes	Yes	?	Died
185735	72 hrs.	At 72 hrs.	Onset	No ? Volvulus	Abdomen silent on admittance.	Died
22290	55 hrs.	Slight at 48 hrs.	Prompt	No	No B.M. (some muscle tension r.l.q. and marked tenderness r.l.q. at 48 hrs. Sharp onset.	Died
22594	50 hrs.	At 18 hrs.	4-5 hrs.	Yes	Enema no results. Low ileum obstipation.	Died
22984	50 hrs.	Presume not at 50 hrs.	At 12 hrs.	Yes	Moderate rigidity, tenderness, 26 hrs.; peristalsis visible 50 hrs.	Died
177034	Died at 50 hrs. without surgery.	Not marked at 48 hrs.	Early	Yes	Rather generalized mod. spasm and tenderness.	Died
176134	38 hrs.	Not marked if present at 36 hrs.	Early	No	"Slight muscle spasm and tenderness" at 36 hrs.	Died
1047	36 hrs.	Very slight 12 hrs.	Prompt	Yes	No B.M. Enema no results. Mass palpable at 12 hrs. Moderate tenderness to deep pressure.	Died
22690	24 hrs. plus	Marked at 24 hrs.	?	Yes. Volvulus of sigmoid	Abdomen silent. Diffuse tenderness. Enema no results; no B.M.	Died
25041	12 hrs.	At 12 hrs.	?	Yes. Large volvulus	Rigid at 7. Diffuse tenderness. Silent at 12 hrs.	Died
4177	48 hrs.	Moderate at 18 hrs. More def. at 48 hrs.	At onset	Hemorrhagic, but believe not gangrenous. Resected 2 ft.	Diff. tenderness and muscle spasm 18 hrs. Rigidity and distention more def. at 48 hrs.	Lived
3497	48 hrs.	Moderate 24 hrs.	Prompt	Apparently not, but hemorrhagic infarction.	"Tenderness and some spasm 24 hrs."	Lived
49036	24-36 hrs.	Evidently none at 24-36 hrs.	Early	No	B.M. not mentioned	Lived
3598	10½ hrs.	None at 10 hrs.	None at 10 hrs.	No	No particular nausea. Some increased peristalsis. No b.m. No results to enema 10 hrs.	Lived

Average time operated from onset excluding abnormally delayed cases—37.45 hours.

Total died..... 10

Total lived..... 4

Mortality..... 71.4 per cent

of all cases studied. It may be said, however, that it is not always so continuous and constant as is sometimes stated. It seems to have no markedly distinguishing characteristics in different types, though it will not occur persistently or consistently in purely venous mesenteric occlusions

from the records to discover any distinguishing characteristics of the pain in any particular type of obstruction. In a general way, however, it would seem more sharp and severe in the folded loop obstructions than in the simple ones. It has, of course, long been recognized that sudden strangu-

TABLE III  
STRANGULATED HERNIA

Case Number	No. Hrs. before Operated	Distention	Vomiting	Gangrene	Remarks	Result
21902	4 days	Not marked at 4 days	In few hours	No	.....	Died
2668	65 hrs.	Flacid 24 hrs.	5 hrs.	Yes. Femoral	No rigidity. B.M. after onset.	Died
23951	48 hrs.	"Somewhat" at 24 hrs.	Early and continuous	No	.....	Died
221334	48 hrs.	Slight at 48 hrs.	Rather constant	No	General tenderness. No rigidity.	Lived
274235	48 hrs. plus	.....	Within 6 hrs.	No	.....	Lived
116537	36 hrs.	No	Early	No	No rigidity.	Lived
23883	22 hrs.	Apparently not	At 10 hrs.	No but darkened	.....	Lived
298635	12-18 hrs.	No	Yes	No	.....	Lived
231136	6-7 hrs.	No	Early	No	.....	Lived
17736	6 hrs.	Apparently not	In few hrs.	No	.....	Lived
23918	5½ hrs.	Apparently not	?	No	.....	Lived

Average time operated from onset excluding abnormally delayed cases—30 hours.

Total died.....	3
Total lived.....	8
Mortality.....	27.2 per cent

without direct lumen obstruction.<sup>2</sup> It is probably more rapid in onset in high simple obstructions, folded loop and strangulated obstructions than in low simple ones. In persistency, severity and frequency it occurs in the different types in the order in which they are named here, i.e., most gravely in high simple obstructions, less so in folded loop and strangulated ones.

Pain at onset is indeed a constant symptom, occurring early in every one of the 200 cases studied. It was impossible

lation of arterial blood supply gives sudden severe pain. Pain in purely venous mesenteric thrombosis without direct gut lumen obstruction is somewhat less severe, and is of colicky nature extending over a longer course than in most types of obstruction.<sup>2</sup>

Visible peristalsis does not seem to be at all a constant finding. In only one case of the 200 was there a note that it was present.

The study well bears out the statements repeatedly made that one or two bowel

movements may occur as the bowel below the obstruction is emptied. *Obstipation*, however, in complete mechanical obstructions is certainly a constant and fairly reliable finding, with the exception of these one or two potential movements. But in the purely venous type of mesenteric occlusion without direct gut lumen obstruction,

tention may be a lethal factor in obstruction in that it may cause an ischemia of mucous membrane, allowing toxins to be absorbed.

Loss of essential salts and fluids is likely to be more rapidly serious and disturbing in obstructions high up in the small gut than in lower obstructions.

TABLE IV  
MESENTERIC THROMBOSIS AND INTUSSUSCEPTION

Case Number	No. Hrs. before Operated	Distention	Vomiting	Gangrene	Remarks	Result
161234	7 days	Def. at 7 days	For duration of illness. No blood seen.	Yes (?) Hemorrhagic infarction.	Constant dull pain one week with pulling pain. B.M. reg. General tenderness and muscle spasm.	Died. Mesenteric thrombosis, evidently venous.
179834	48 hrs. Iliostomy (died)	Marked 48 hrs.	Within few hrs.	Yes	Tender entire abdo. at 48. Intra fluid wave present. App. no fluid levels in gut. Endocarditis.	Died. (Mesen. throm.)
37434	27 hrs.	Slight at 27 hrs.	In 6 hrs.	?	No B.M. from enema and no blood. Slight muscle spasm 6 hrs. Gen. tenderness.	Died. Intuss.
90834	48 hrs.	Evidently somewhat	Onset	No	Movable mass cecal region.	Lived. Intuss. Fibroma small intestine
69335	24 hrs.	?	Prompt	No	Bloody stool to enema.	Lived. Intuss.

bowel movements may occur daily over many days, as happened in the one (apparent) case of this series.

#### REVIEW OF PATHOLOGIC PHYSIOLOGY AND DIVISION OF SIGNS INTO EARLY AND LATE ONES

One should keep in mind that interference with the arterial blood supply to the point of gangrene gives the most fulminating picture in obstruction; that loss of salts is often an important factor but one which is easily combated; and that dis-

One should always remember that in folded loop obstructions there is not only obstruction to the main continuity of the gut, but also an additional obstruction of a loop. The latter may become distended quite rapidly, endangering either the terminal or the primary blood supply of the loop, and causing a fulminating picture.

Again, there is the possibility of fairly early rupture or increased permeability of the large bowel, due to distention in the large gut obstructions, allowing fatal peritonitis. An understanding of the mechanics of these different types allows for fuller

appreciations of the potential variability of signs and symptoms.

*Early Signs and Symptoms.* Our most reliable finding in direct lumen obstructions is available through the use of the x-ray. It has been repeatedly demonstrated that gas and fluid levels in the small bowel become characteristic in these direct lumen obstructions in three to six hours. However, we must appreciate that this finding may not be present in some of the conditions where the lumen is not directly closed, as in some venous mesenteric and arterial mesenteric occlusions. Also we know that fluid levels will occur

some of the early signs and symptoms, of course, being carried over into the later picture.

#### CONCLUSIONS

1. As far as is possible the differences in the signs and symptoms as they appear in the fundamentally different types of intestinal obstruction are identified and discussed in this analysis of 200 cases. An effort is made to determine the time of appearance and consistency of signs and symptoms in the different types and to correlate these findings with mortality rates. The unnecessarily high mortality of

TABLE V

#### DISTENTION

(As to whether reasonably certain clinically absent or present in particular twelve-hour periods)

	Simple Obstructions		Folded Loop Obstructions		Strangulated Hernias	
	Reasonably Certain Present	Reasonably Certain Not Present	Reasonably Certain Present	Reasonably Certain Not Present	Reasonably Certain Present	Reasonably Certain Not Present
First 12 hours.....	0	7	Possibly 2	5	0	10
Second 12 hours.....	0	4	4	5	1	5
Third 12 hours.....	1	4	3	3	1	3
Fourth 12 hours.....	2	2	4	Possibly 1	Possibly 2	1
Fifth 12 hours.....	3	0				

in indirect lumen obstructions as in paralytic ileus. Actually we cannot list unqualifiedly any of the signs and symptoms as being pathognomonic for all types of conditions listed under the intestinal obstruction heading. But *with limitations as previously discussed*, we may list early signs of obstruction as being vomiting, pain, tenderness to deep pressure, obstipation, and fluid or gas levels to roentgenologic study. Increased peristalsis is also usually present at an early stage in the direct lumen obstructions. These signs and *these only* should be considered as at all reliable early ones.

Under *late signs and symptoms* may be included distention, decreased peristalsis, marked rigidity (peritonitis), evidence of alkalosis or acidosis, and collapse, with

obstructions is in part due to failure to make a more clear-cut distinction between early and late signs and symptoms; and in part to failure to appreciate the potential variability of the pathologic physiology of different conditions ordinarily listed under the intestinal obstruction heading. The potential scarcity of clear-cut objective clinical findings in early stages should be more fully realized. Too frequently we wait for clinically pathognomonic signs and symptoms to develop without appreciating that such signs and symptoms may appear only late in the pathologic process when a high mortality with any type of present day treatment is inevitable.

2. It is shown in this series that distention, a sign so frequently given as of early occurrence, often does not appear clinically

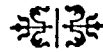
until sufficient time has passed to presage a much higher mortality than would have obtained had treatment been given before the distention was clinically demonstrable.

3. The seriousness of folded loop obstructions is illustrated by the mortality figure (71.4 per cent) which is approximately 12 per cent higher than that for simple obstructions (59 per cent). This is true even though the folded loop obstructions were operated on about twenty hours (average time from onset 37.45 hours) earlier than the simple ones (average time from onset 59.5 hours).

4. The gravity of gangrene is indicated by a mortality in this series of 100 per cent.

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THE length of life in obstructive jaundice is always limited. . . . Bile loss seems to be far afield from the toxicity of bile. The toxicity is due to the absence of bile, not to its presence.

From—"Bile—Its Toxicity and Relation to Disease" by O. H. Horrall (University of Chicago).

# ACUTE ADRENAL CORTEX EXHAUSTION AND ITS RELATIONSHIP TO SHOCK

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THE question of the adrenal cortex as an important factor in the vast endocrinologic hook-up has been suggested, but whether due to lack of pure potent extract or to a lack of knowledge of its functions, it has been more or less regarded as insignificant by investigators, as well as by average practitioners. One of the first to recognize its importance was the late Dr. A. Scott Warthin, formerly professor of pathology at the University of Michigan, who, in autopsy reports of patients dying from shock, never failed to mention the condition of the adrenal glands and the state of exhaustion present therein. Wolf<sup>1</sup> has suggested the subtle but vital importance of the adrenals a number of times in his comprehensive discussions of the other glands of the endocrine chain. Various writers and pathologists have, from time to time, mentioned possible functions and effects of the adrenal cortex, but through diligent searching, it is found that little accurate information regarding the functions and secretions can be obtained.

In considering a new subject of this type, it is deemed appropriate to review briefly the sequences of thought and experience which have developed and rationalized the idea, and have led to the use of adrenal cortex extract as a treatment for the prevention and relief of the age-old condition, surgical shock.

During the past few years, much progress has been made in the study of the endocrine glands and their effect on the human body in health and disease. We know that in perfect health, all of the endocrine glands are in a correlated balance, which in turn gives a healthy, normally functioning body and mind. We

know also that there are many different conditions of modern life which affect the human body and produce either increased function or exhaustion of one or more of these interrelated glands with grave and serious effects upon the body as a whole.

Of these, probably the best understood interrelationships are the gonad-pituitary complex and the hyperthyroid complexes, with their far-reaching physical and mental effects. The pancreatic complex and insulin-secreting disturbance, commonly known as diabetes and various other conditions such as gigantism, acromegaly, dwarfism, etc., are well established syndromes in the medical world. At the present time it is a conceded fact that the endocrine glands, each having a definite function of its own, are so closely interrelated in their actions upon the body that they function in conjunction with each other and are interdependent, often requiring activating or complementary secretions or hormones for full function.

Much research has been done on the function of the adrenal gland and its anatomic parts, the medulla and the cortex. Adrenalin, the secretion of the medulla, has been known and used extensively for many years. On the other hand, the cortical portion and its functions remained a mystery, with the exception of one fact: medical men knew that life in its higher forms could not exist for more than a limited number of hours when all of the cortical tissue had been removed or destroyed.<sup>2</sup>

Addison's disease has been known to be due to a progressive destruction of the adrenal gland, generally as a result of tuberculosis. It was a hopeless condition, controllable only since the recent per-

fection of a satisfactory adrenal cortex extract,<sup>3</sup> the lack of secretions of the medullary portion of the gland being

medicine and surgery, generally attributable to three main causative factors: (1) acute and chronic infectious diseases in

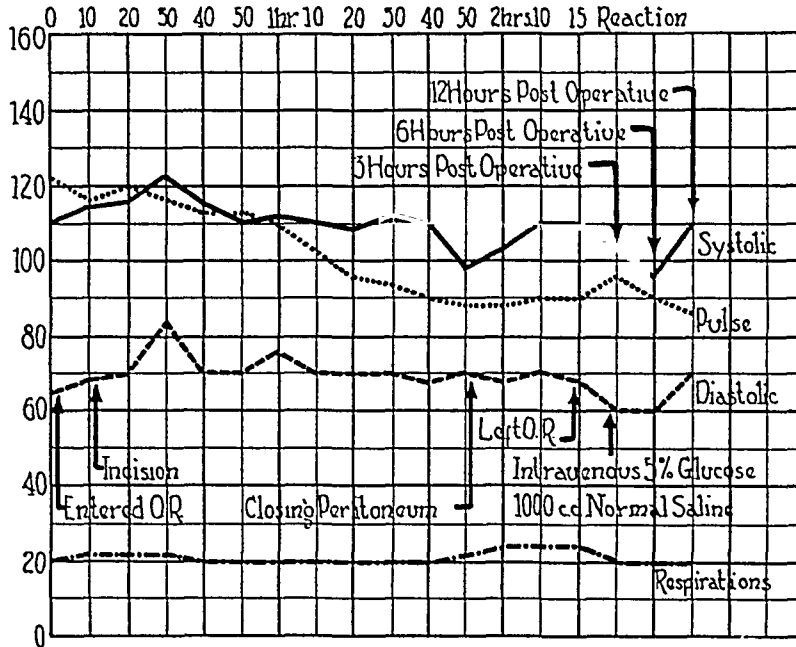


FIG. 1. Case 1. Operative period. Closure of colostomy. Fecal fistula following postoperative gas gangrene (one year previous). Extensive destruction of muscle present. Colostomy into sigmoid. General condition on admission fair. Nitrous oxide and ether anesthesia.

compensated for by the secretions of the thyroid gland.<sup>4</sup> Studies of Addison's disease and research on adrenalectomized animals have shown definite blood chemistry changes similar in both instances, as well as other related clinical findings. The chemical findings most marked are a lowering of sodium and the blood chlorides,<sup>2,5,6,7,8,9,10</sup> an increase in non-protein nitrogen, a decrease of the plasma in the blood stream,<sup>11</sup> and a disproportion from the normal increasing as death approaches. The clinical picture is one of asthenia, beginning with progressive weakness, followed by falling blood pressure, skin pigmentation, edema, failing kidney function, unequal distribution of the blood volume in the vascular system, anorexia, nausea and vomiting, rapidly failing heart action, embarrassed respirations, great physical weakness, coma and death.

Acute conditions, clinically similar to Addison's disease (with the exception of the pigmentation), are frequently seen in

their terminal stages; (2) surgical and traumatic shock; and (3) combinations of both causes. I cite the first cause only to mention it and its possibilities in the way of treatment. My own clinical experience has been limited in this field. It is with the second and third types of cases that I have become familiar, those of surgical shock with or without complicating infections of a surgical type.

Much time and study has been given to the subject of shock, in its varying degrees, throughout the history of medicine and surgery. Many volumes have been written, many new theories evolved, and many new treatments used in an effort to overcome this one great cause of mortality. Causes of shock may be classed in four main groups: (1) traumatic, (2) surgical, (3) toxic, and (4) psychic. These causes, singly or collectively, are capable of producing reactions in either humans or animals of a severity sufficient to produce death.



It is an accepted fact that death from shock, whatever its direct cause may be, produces a well defined syndrome, namely: toxic absorption from traumatized areas, and its effects in the production of delayed traumatic or surgical shock.

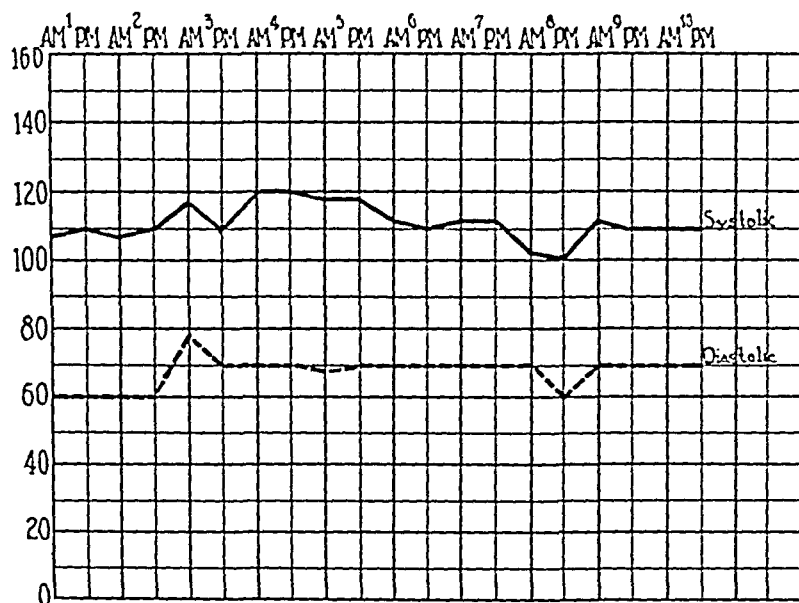


FIG. 2. Same patient as in Figure 1. Postoperative period. Illustrates "settling" of blood pressure to normal following surgery.

loss of blood volume, either from hemorrhage or a rapidly progressing abnormal distribution of the blood volume within the circulatory system. This is due to loss of vascular tone, with diffusion of the plasma through the capillary walls, and stagnation of the cellular elements in the small capillaries. This in turn produces a rapidly falling blood pressure with decreased nutrition and oxygenation of all body tissues, embarrassment of heart action due to lack of blood volume with which the heart muscle works, and finally death from inanition of the vital cells of the body.

Numerous authors have advanced plausible theories as to where this vascular dilatation takes place in the body. The earlier school of thought stated that there was a dilatation of the vascular system in the splanchnic area with pooling of blood at that point. This has been gradually abandoned as pathologists failed to find any great distention of these vessels at autopsy in patients who had died from shock. During and after the war, Quenu<sup>12</sup> and other French and English observers devoted much thought and research to

From their observations, there can be no doubt that the absorption of toxins from degenerating necrotic traumatized areas is a factor in shock production. However, the research of Cannon,<sup>13</sup> Simonart<sup>14</sup> and others has shown that this factor alone is not sufficient in itself to produce the syndrome in its entirety, except in very extensive tissue destruction. Even then, the elements of pain and other psychic reactions are present and contribute to the total syndrome picture.

In 1933, Norman Freeman<sup>15</sup> called attention to the pain factor in the production of shock, and with his experiments proved that when the nerves from the traumatized areas were severed, the shock was greatly reduced. He further showed that the sympathetico-adrenal system was quickly affected in shock, causing vasoconstriction of all vessels in the body except those of the heart and skeletal muscles.

In 1925, Cannon and Britton<sup>16</sup> demonstrated the fact that animals manifesting sham rage secreted an abnormal amount of adrenalin into their own blood streams and developed the clinical shock syndrome,

reducing the amount of blood in the current circulation with falling blood pressure, and at the same time producing constrict-

integration of the nuclei with granulosis within the cell membranes of three types of body cells, the Purkinje cells of the

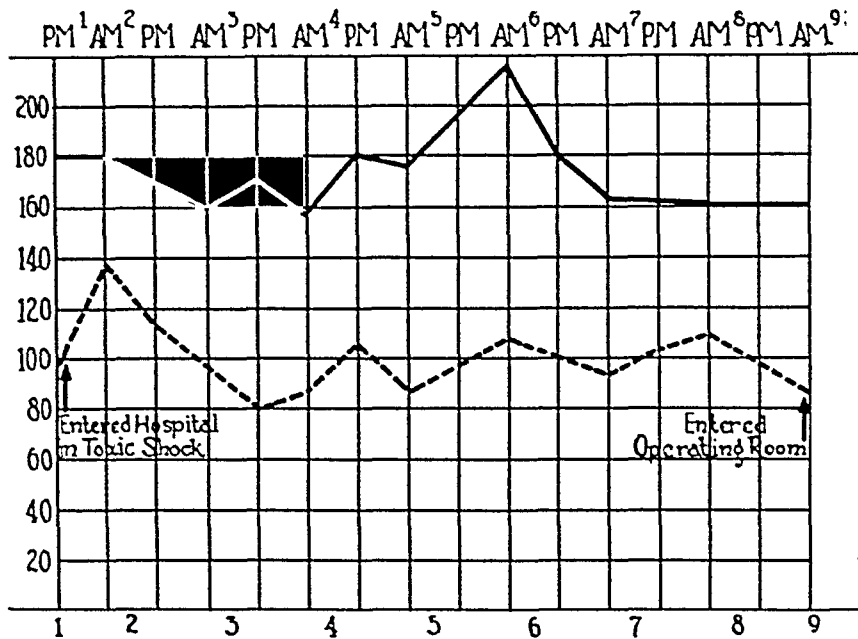


FIG. 3. Case III. Preoperative. Acute cholecystitis, lithiasis, chronic toxic myocarditis, and acute nephritis. Cholecystectomy performed under nitrous oxide and ether anesthesia.

tion of the cutaneous and splanchnic blood vessels, with dilatation of those in the skeletal muscles. Krogh<sup>17</sup> further showed an enormous opening of the capillary beds in these areas with outpouring of the plasma through the capillary walls into the spaces between the muscle fibers, and stagnation of the cellular elements in the capillaries in these muscle areas. Freeman further demonstrated that the continuous injection of adrenalin into animals over a period of two hours lowered the blood volume as much as 27 per cent and produced the shock syndrome.

Prior to the past five years, very little was known in regard to the part which might be played in the shock syndrome by the cortical portion of the adrenal gland. As before mentioned, references had been made to the possibility of this gland being involved in the shock syndrome for a considerable number of years by Dr. Warthin in his autopsy reports. More recently, Crile<sup>18</sup> and his associates have shown that in patients who died of shock, microscopic section at autopsy showed a definite dis-

brain, the interlobular cells of the liver, and the cortical cells of the adrenal glands. Other research reported during the last few years has revealed definite changes in the blood picture in adrenal cortical insufficiency, namely, lowering of blood chlorides and sodium with increase of non-protein nitrogen and dehydration, which again correlates with the blood changes noted in surgical shock.

In 1933, Loeb and his associates,<sup>5,7</sup> as well as Harrop and his associates,<sup>6,10</sup> reported that in adrenal insufficiency, there was a loss of sodium content in the blood stream, accompanied by dehydration. Stewart and Rogoff,<sup>9</sup> and Harrop also reported that the administration of fluids and sodium salts to adrenalectomized animals was of distinct benefit both in correcting the clinical condition and in prolonging the life of the animals. They further showed that with the administration of cortical extracts they were able to obviate these profound water and salt balance disturbances. The recent researches of Maddock and Coller on water balance and

dehydration in surgery<sup>19</sup> have definitely shown that surgical shock is reduced and controlled to a high degree by the properly

From a careful search of the literature thus far, reports of the application of the cortical hormone in the treatment of

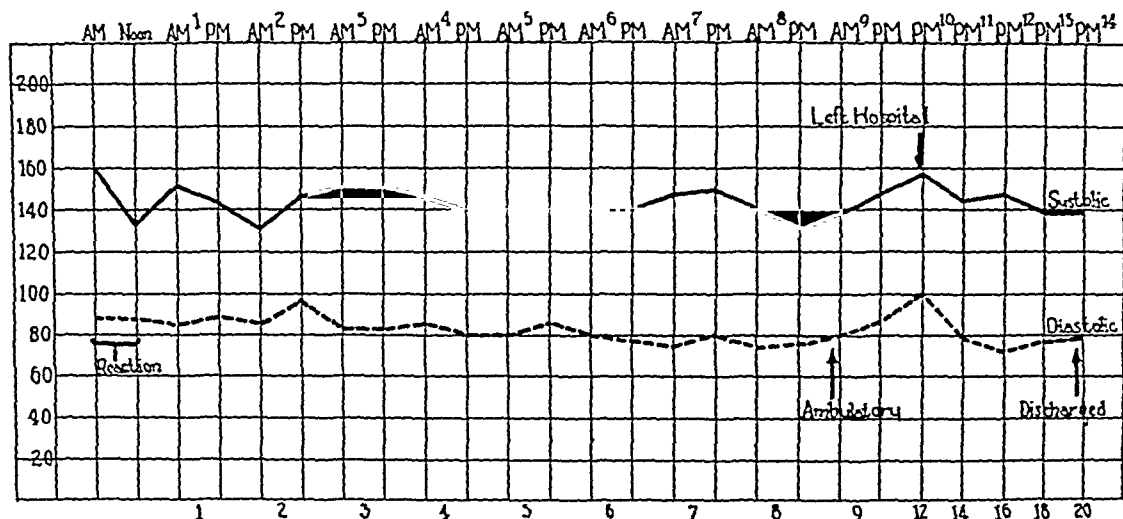


FIG. 4. Same patient as in Figure 3. Postoperative period.

maintained balance of fluid, blood chlorides, sodium, potassium and calcium, which again suggests a possible relationship existing between the known adrenal cortex deficiencies in animals and surgical shock.

Many investigators have maintained adrenalectomized dogs in apparently normal physiologic condition for long periods of time by the daily administration of sufficient amounts of the extract of the adrenal Cortex.<sup>20,21</sup> These authorities have pointed out that the syndromes of anaphylactic shock, like those of adrenal insufficiency, can be alleviated or postponed by the administration of sodium salts, and prevented by the administration of the cortical hormone.

In surgical and traumatic shock the syndromes and blood chemistry findings are very similar to those encountered in adrenal cortical insufficiency in animals. Swingle and his associates<sup>22</sup> have given a detailed comparison of the two conditions, and have reported experiments on dogs which would indicate that the hormone might be of value in the treatment of surgical shock.

shocked conditions have been very limited, while there are a few reports on the use of cortical extract in the treatment of severe infections, toxemias and allied toxic shock. Zwemer,<sup>23</sup> in 1931, reported the use of adrenal cortex extract in the treatment of severe cases of intestinal intoxication in babies, followed by marked improvement within twenty-four hours. Bamberger and Wendt<sup>24</sup> in 1935, reported a beneficial action of the cortical hormone in the treatment of the circulatory system, which had been weakened by diphtheria. Wilson and associates,<sup>25</sup> in 1936, reported the use of the adrenal cortex extract with very encouraging results in the treatment of the acute toxemia and shock following extensive burns. Wenner and Cone<sup>26</sup> reported the improvement of severe pyogenic infections following the administration of from 2 to 7 c.c. of adrenal cortical extract intravenously at intervals of two or more days.

In 1932, I began using desiccated adrenal substances in the treatment of non-surgical nervous, asthenic patients, whose symptoms closely simulated hyperthyroidism, but whose basal metabolic rates were normal or subnormal. In general, these

patients were well nourished individuals whose chief complaints were rapid heart action from the least excitement or moder-

quillity was restored and later electrocardiograms showed normal heart action in all instances.

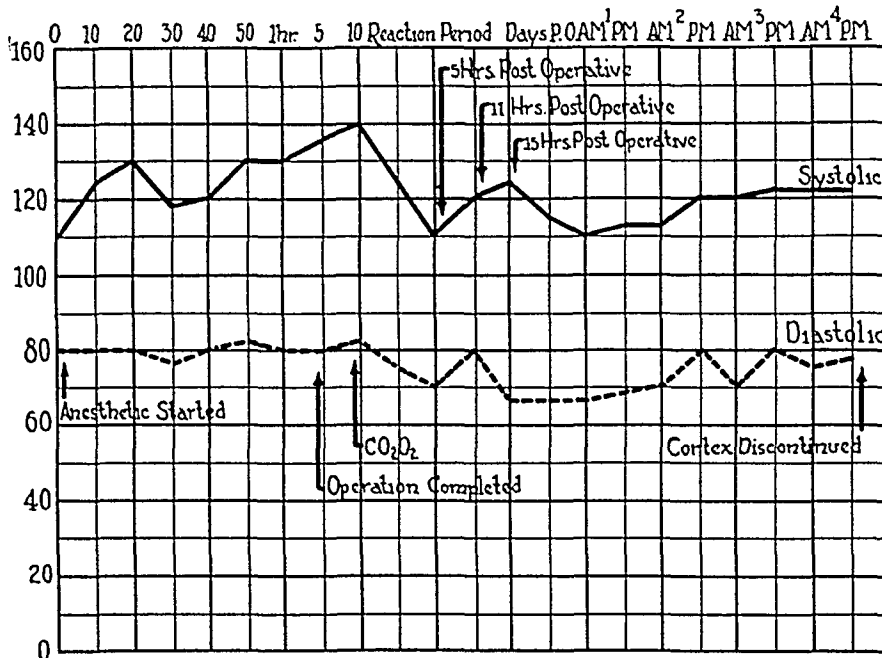


FIG. 5. Case IV. Appendectomy for chronic appendicitis in male of 23 years. Nitrous oxide and ether anesthesia.

ate exercise and ready fatigue. When subjected to any unusual psychic stimulus, they developed tachycardia, with a profuse cold, clammy perspiration, particularly noticeable in the palms of the hands and the soles of the feet. A coarse tremor of the hands was noted in most instances, accompanied by general muscular weakness. Electrocardiograms showed low voltage curves with either bradycardia or normal heart rates.

It was first thought that these patients belonged in the class of thyroid exhaustion, and small doses of desiccated thyroid substance were prescribed. This treatment aggravated the condition, however, and was therefore discontinued.

A diagnosis of hypo-adrenia was then made and the patients were given desiccated whole adrenal substance. This produced aggravation of a type which indicated that these patients were receiving an excess of adrenalin. Desiccated cortical substance was substituted with favorable results. Their symptoms were gradually alleviated, with a slow rise in blood pressure to normal. Mental tran-

The striking similarity between the symptoms exhibited by these patients and those of a patient going into gradual surgical shock led me to believe that desiccated adrenal cortex would be of benefit in preparing asthenic patients for surgery. A series of such cases was started and I noted less shock from operation than was present in referred patients not prepared in this manner.

From the similarity of clinical pictures exhibited in shock and in known cases of adrenal cortical insufficiency (Addison's disease); from the comparison of the blood chemistry findings in adrenalectomized animals and patients in surgical shock; as well as from my own clinical experience in the treatment of hypo-adrenia patients and their preparation for surgery with pure desiccated adrenal cortex substance, I decided to use adrenal cortex extract in the first case of extreme surgical shock presenting itself.

In January 1936, a pelvic surgical patient (Case 1) developed a fecal fistula accompanied by an extremely virulent infection in the abdominal incision. She

rapidly became toxic and went into shock. The infection was spreading in spite of all known methods of treatment. I decided

Gas gangrene antitoxin was given frequently in 5,000 and 10,000 unit doses intravenously. Four thousand c.c. of fluids

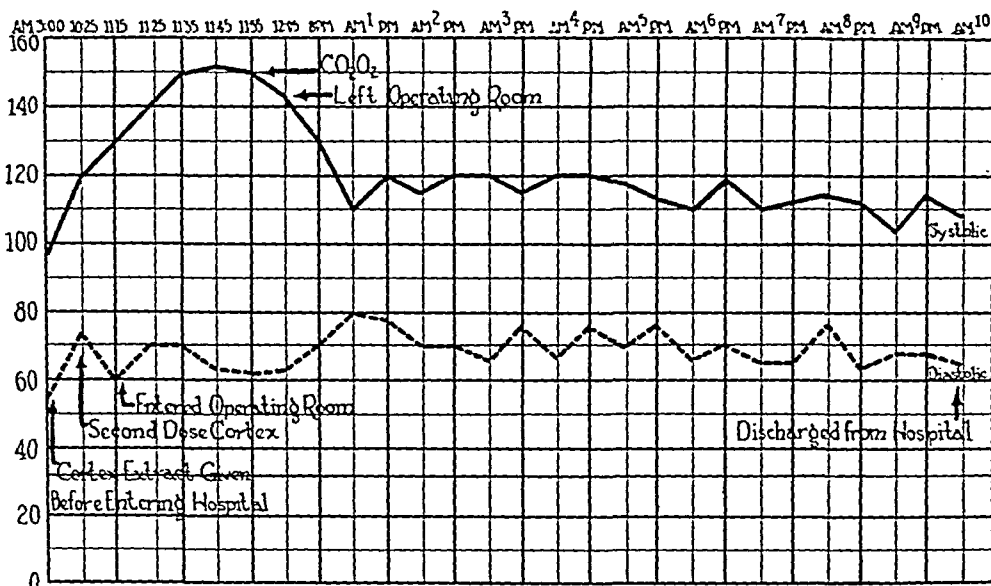


FIG. 6. Case v. Ruptured ectopic pregnancy. Entered hospital in shock. Approximately 500 c.c. of free blood in abdomen. Nitrous oxide and ether anesthesia.

to draw blood for chemical determination of the chloride and non-protein nitrogen contents, and at 5 P.M., the laboratory findings were: blood chlorides 340 mg. per 100 c.c. of plasma; non-protein nitrogen 59 mg. per 100 c.c. of blood. At 6 P.M., a large dose of adrenal cortex extract was administered. At that time, the patient was comatose, with all the typical signs of deep shock, and the relatives were notified that she would not live through the night. At 11 P.M., she was conscious and coherent. Blood chemistry at that time revealed a striking difference from the 5 P.M. samples. The blood chlorides were 528 mg. per 100 c.c. of plasma, and the non-protein nitrogen 30 mg. per 100 c.c. of blood. It should be mentioned that no treatment or medication other than the injection of adrenal cortex extract was administered in the interval between 5 P.M. and 11 P.M. Twenty-four hours later, typical clinical signs of gas gangrene infection became apparent. Blebs developed under the skin and the crepitation extended well out from the incision to the right. Cultures proved positive for *B. welchii*.

were administered daily and adrenal cortex extract, 4 to 6 c.c., was given intramuscularly each twenty-four hours. Following the original blood chemistry, several subsequent determinations were made with normal blood chlorides and non-protein nitrogen readings each time. This patient was able to resume her normal employment four months later, and on November 15, 1936, returned to the hospital for closure of a colostomy following the original operation.

This case served as a background for further clinical research, and in March 1936, another case came under my care which added further to my clinical knowledge of the possibilities of this type of treatment. A young boy (Case II) entered the hospital with a diagnosis of acute appendicitis, having been referred by another physician. He was acutely ill and was operated on at once. The appendix was found to be ruptured and general peritonitis developed. Again adrenal cortex extract was used postoperatively. The patient responded and recovered rapidly.

Analytic studies of these two cases convinced me that this potent substance should be of value in fortifying all surgical patients for the impending shock. I decided

Studies were made of blood chemistry and blood pressure, as well as the clinical aspects of the cases postoperatively, with striking results:

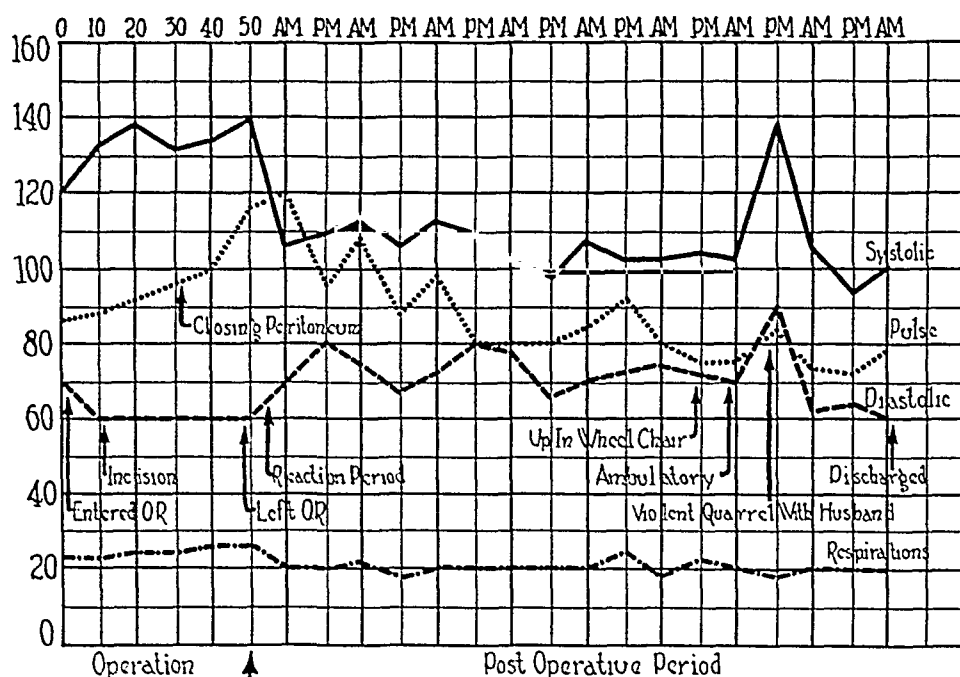


FIG. 7. Case VI. Gangrenous appendix with localized peritonitis. Appendectomy performed and drains inserted. Nitrous oxide and ether anesthesia. Condition of patient on admission poor. Appendicitis occurred three weeks post-partum.

to use intramuscular injections of adrenal cortex extract postoperatively, and later, both before and after surgery, to see if the ordinary surgical shock could be avoided or at least lessened.

From clinical observations on these early cases, a technique has been developed in the use of adrenal cortex extract in the prevention of surgical shock. Intramuscular injection of from 1 to 2 c.c. is given at an interval of from eight to eleven hours preoperatively, and a second injection of 1 to 2 c.c. one and one-half hours prior to operation. All drugs of a sedative nature which of themselves would produce a drop in blood pressure have been eliminated from the preoperative preparation. Adrenal cortex extract is given postoperatively in 1 c.c. doses at intervals of from six to twelve hours during the early postoperative period. The time of discontinuance of this treatment depends entirely upon the patient's condition and the blood pressure readings.

1. Blood chlorides and sodium were maintained at or near the same point in all cases where the chemistry could be obtained, thus giving a normal balance of body electrolytes and undoubtedly maintaining normal tissue osmotic reactions. This chemical factor is again of great value in the maintenance of normal post-operative water balance both in tissues and in the blood stream.<sup>19</sup>

2. Blood non-protein nitrogen was maintained at or below the preoperative levels.

3. Blood calcium and phosphorous were run in a few cases and showed no appreciable change.

4. Heart action has been stabilized and fibrillation eliminated throughout the time that the cortical extract was administered. (Cases III and VIII.)

5. In one case, it has been noted that by the injection of 5 c.c. of adrenal cortex extract, a urine with a three plus albumin reaction became free of albumin and casts in eighteen hours. One thousand c.c. of

5 per cent glucose in normal saline was given intravenously in conjunction with the adrenal cortex extract during this levels were maintained at or near the pre-operative level throughout the operation and in the postoperative period. The usual

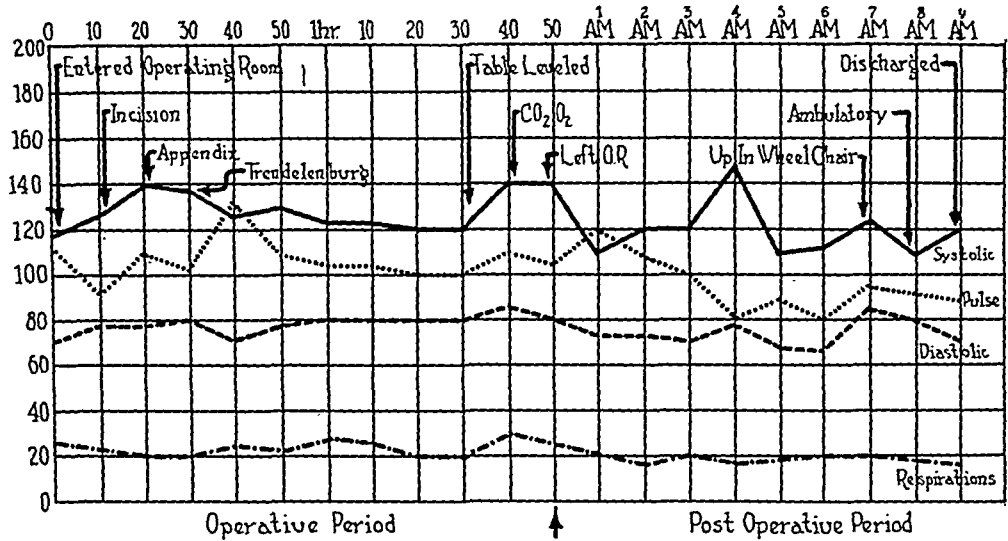


FIG. 8. Case VII. Pyosalpingitis, multiple infected ovarian cysts, pelvic adhesions, chronic appendicitis. Bilateral salpingectomy, left oophorectomy and appendectomy performed under nitrous oxide and ether anesthesia.

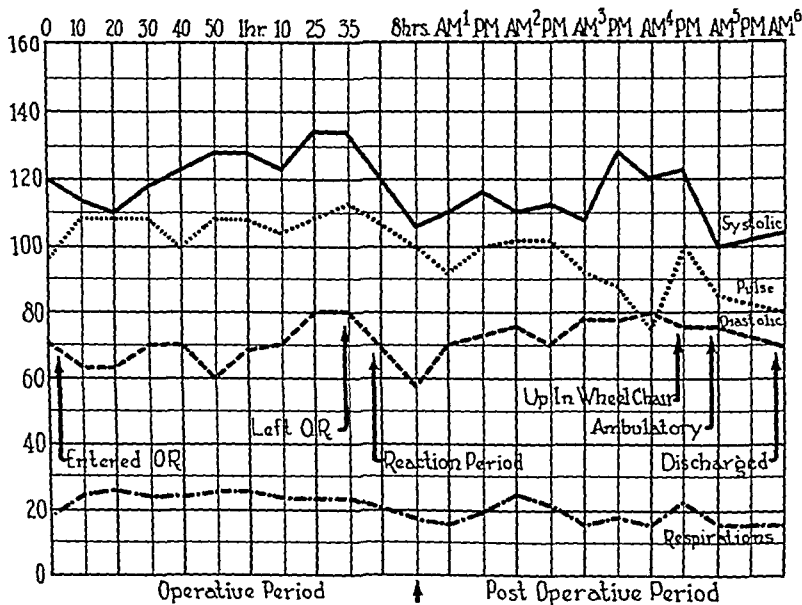


FIG. 9. Case VIII. Thyroid adenoma. Subtotal thyroidectomy done under nitrous oxide anesthesia.

period, but no other medication was used.

In patients who were given adrenal cortex extract in large doses at intervals of eleven hours and one and one-half hours preoperatively along with the usual preoperative preparation, blood pressure

curve during this operating period shows a proportionate rise in both systolic and diastolic pressures, with the maintenance of a normal pulse pressure throughout the operative period, followed by a slight drop during the postoperative reaction period and a restoration to the normal preopera-

tive level within a very few hours. (See graphs.) Pulse rates showed little or no acceleration from the preoperative readings during both the operation and postoperative reaction from anesthesia. Loss of blood fluid by excessive diaphoresis has not been noted in any of these cases, and the usual postoperative period of sweating during the reaction from the anesthetic has been avoided in all cases. Dehydration has not been noted clinically in any of the cases. Abdominal distention, gas pains, and other signs of a decreased peristalsis of the abdominal viscera have not been present. Paralytic ileus has not been seen in any of the cases. Fluids and solid foods have been retained early and comfortably, with a quick return of the normal appetite in all cases.

Healing of the incision has been rapid, with the early formation of firm, narrow scars noted in all cases. Scars which have been examined from four to six months later have shown no spreading or widening of the scar area, and maintain a narrow, normal texture. The general appearance of these patients has been good at all times. The skin has been normal in color, even when reacting from the anesthetic. The patients have been mentally relaxed, calm and coöperative at all times. Arterial and venous circulation has appeared normal throughout the body, with no areas of edema showing at any time.

There has been a notable decrease in the pain experienced by these patients during the postoperative period, and considerably less narcotics have been needed to control this factor than I formerly found necessary in similar types of cases. Resistance to infection has apparently been increased, as evidenced by Cases I, II, and III, and it is also to be noted that in Case I, there was never any anaphylactic or serum reaction noted, in spite of the fact that frequent injections of gas gangrene antitoxin were given. In one case it was observed that there was a marked relief from hypertension where this treatment

was used after the removal of an infected gall-bladder with cholelithiasis. (Case III.)

The cortical extract used in this series of cases was prepared according to the method of Cartland and Kuizenga.<sup>27</sup>

The case studies with blood pressure graphs accompanying this article have been taken from actual clinical work comprising fifty-two cases seen over a period of fifteen months.

#### CASE REPORTS

CASE I. Female, age 43. Admitting diagnosis, chronic pyosalpingitis.

*History.* Chronic pelvic inflammatory disease had been present for several years. Colpotomy had been done three times during the past six years in the home. Free drainage of pus was obtained on the first two occasions, but none was obtained at the last operation, in October 1935. The patient was referred to me on December 27, 1935. There was no preoperative administration of adrenal cortex extract.

*Operation.* Bilateral salpingo-oöphorectomy and routine appendectomy were done. On the second postoperative day, gas and fecal matter were expelled per rectum. Following this, the abdomen became distended, and there were nausea, vomiting and hic-cough. Profuse drainage of pus from the incision began on the third day. The nausea and vomiting persisted and a Levine tube was inserted. Intravenous glucose and saline were given freely throughout the second and third days. On the fourth day, there was a distinct fecal odor to the drainage, but no fecal particles were present. On the sixth day, the patient became comatose and went into severe toxic shock.

Blood chemistry at 5 P.M. revealed: blood chlorides at 340 mg. per 100 c.c. of plasma; non-protein nitrogen 59 mg. per 100 c.c. of blood. Adrenal cortex extract, 2 c.c., was given intramuscularly. At 11 P.M., the patient was conscious and coherent. Blood chemistry determinations showed blood chlorides 528 mg. per 100 c.c. of plasma; non-protein nitrogen 30 mg. per 100 c.c. of blood. The patient did not receive any other medication or fluid either by mouth or intravenously during the period from 5 P.M. until 11 P.M.



Definite clinical signs of gas gangrene infection developed in and around the incision on the eighth day and cultures were taken. Gas gangrene antitoxin was given intravenously in 5,000 and 10,000 unit doses at twelve-hour intervals, and the body fluid intake was measured to meet 4,000 c.c. daily. The amount which could not be taken by mouth were given as 5 per cent glucose in normal saline intravenously. Adrenal cortex extract was given at regular intervals, an average of 4 c.c. daily being maintained.

The temperature ranged from a high of 104.6 degrees to a low of 101 throughout the five days following the development of gas gangrene, and then gradually subsided. The areas of gas gangrene blebs and the subcutaneous crepitation reached a maximum on the third day following the recognition of infection. At that time, crepitation extended upward to the right axilla, well back over the dorsal surface of the body, nearly to the midline and down over the crest of the right ilium. The temperature gradually subsided and reached normal on the eighteenth postoperative day, where it remained, except for occasional subnormal periods.

The convalescence was gradual; the patient recovered and left the hospital seventy-one days following her admittance.

She returned to normal work about four months following the original operation. On November 15, 1936, she returned to the hospital for closure of the colostomy resulting from the first operation. She was prepared for three days and on November 18, 1936, the old scar was removed from the abdominal wall, masses of adhesions, including the omentum and six loops of the ileum were dissected free from the scar area. The colostomy was dissected free from the scar in the abdominal wall and closed. The abdominal wall was then closed, repairing the ventral hernia resulting from the gas gangrene infection, using fascia to replace the right rectus muscle which had been completely destroyed by the infection. Complete blood pressure records of this operation are presented. (Fig. 2.) During the second operation, this patient did not show shock at any time. Her recovery was uneventful and on the eighteenth post-operative day, she returned by train to her home, 150 miles distant.

Laboratory reports of the first operation showed cultures from the wound positive for *B. welchii*, using Wilson and Blair medium.

CASE II. M. R., male, age 9 years, was referred by another physician. The diagnosis on admission was acute appendicitis, ruptured appendix with acute peritonitis.

No preoperative preparation with adrenal cortex extract was given. The patient was given a routine abdominal preparation and operated on immediately upon entrance to hospital. The ruptured abscessed appendix was removed. Generalized peritonitis with free pus in the abdomen was present, and there was no protective walling off of the area by omentum. Multiple drains were placed in the abdomen and the usual closure made.

*Postoperative Period.* The abdomen was distended and tense at the end of twenty-four hours, with nothing passing by rectum. After thirty-six hours the abdomen was still distended and hard, with nothing passing by rectum, despite the fact that hot stools had been applied continuously; warm enemas, pitressin, and rectal tubes were used without results. At that time adrenal cortex extract was given in 1 c.c. doses every six hours and the other treatment continued. Twelve hours following the administration of adrenal cortex extract the bowel was opened and the abdomen soft. Free drainage of pus was established and the general condition of the patient improved.

During the postoperative period to this point, the patient had received by intravenous injection an average of 2,000 c.c. of 5 per cent glucose in normal saline each twenty-four hours. However, following this period, the patient was coöperative and fluids were freely taken by mouth. The recovery was prompt and uneventful.

CASE III. A. A., female, age 56 years. The diagnosis on admission was infective cholecystitis with cholelithiasis.

The present illness had begun six days previous. On entrance to the hospital the patient was in shock and comatose. Her blood pressure was 180/98; the heart showed fibrillation and irregular extrasystoles. The abdomen was distended and rigid. Laboratory findings on admission showed the following:

*Urinalysis:* reaction acid; color amber; specific gravity 1.028; albumin three plus; sugar negative; few pus cells and numerous finely granulated casts present.

*Blood Count:* hemoglobin 90 per cent; red blood count 4,950,000; white blood count 19,000; differential count filament cells 60 per cent, non-filament cells 15 per cent, lympho-

cytes 20 per cent, endothelial cells 3 per cent, eosinophile cells 3 per cent.

*Blood Chemistry:* Non-protein nitrogen 34 mg. per cent; blood chlorides 578 mg. (NaCl) per cent; icterus index 3.3. Kahn test negative.

*Treatment.* Directly following the drawing of blood for laboratory determinations, the patient received 1,000 c.c. of 5 per cent glucose in normal saline solution intravenously, and 3 c.c. adrenal cortex extract intramuscularly. Two hours later the patient was taking fluids freely by mouth and retaining them. The bowel was opened with warm enemas, and five hours following the first injection of adrenal cortex extract, when a second injection of 2 c.c. was given, the patient was resting quietly and comfortably. During the night fluids were forced by mouth whenever the patient was awake, and the following morning she was conscious and coöperative. A second urinalysis at this time gave results as follows: reaction acid; color amber; albumin negative; sugar one plus positive; few pus cells present. No casts in specimen.

The abdomen at this time was soft and relaxed except for tenderness and moderate spasm of the muscle in the upper right quadrant. The heart was regular in its action and showed no signs of fibrillation or extrasystoles. The third day in hospital, the general condition was improving, with the patient taking soft food and fluids freely without any discomfort. Urinalysis then showed reaction acid; color amber; albumin negative; sugar negative; few pus and epithelial cells present. This would indicate that the sugar present in the second sample was simply a spilling of glucose from the intravenous injection of the first day in the hospital, and not evidence of an abnormal kidney function.

During the next five days the patient's condition continued to improve, except for two short intervals, when she apparently passed more gallstones. After careful preparation she was taken to the operating room on the eighth day after entrance to the hospital and cholecystectomy done.

This patient received a maintenance dose of 1 c.c. of adrenal cortex extract at twelve hour intervals during the preoperative period after the first twelve hours in the hospital. Blood pressure readings were not taken in the operating room and for that reason are not included in the graph in this case. (Fig. 3.)

*Postoperative Period.* The patient was comfortable and showed no distress. There was no period of diaphoresis during the reaction from anesthesia. Fluids were taken and retained in three hours. The abdomen was soft and flat at all times and the bowel opened on the second day with enemas. Recovery was rapid and the patient was able to be up in a chair on the ninth day postoperatively. She left the hospital on the twelfth day, the incision being completely healed and firm.

Adrenal cortex extract was given in 1 c.c. doses every six hours for four days and every twelve hours thereafter until the patient was discharged from hospital. She remained in the city at the home of her daughter for nine days before returning to her home which is about fifty miles from Detroit. Immediately on her return home she opened her gift shop and has continued her normal routine of life without discomfort since that time. (Fig. 4.)

CASE IV. F. M. J., male, age 23 years, was admitted with a diagnosis of chronic appendicitis. He had had several acute attacks during the previous five years.

X-ray examination showed that the appendix could not be visualized with barium mixture. The cecum was immobilized, probably from adhesions.

The patient was prepared in the usual manner, except that 2 c.c. of adrenal cortex extract were administered eleven hours, and again one and one-half hours preoperatively. This patient did not at any time show a blood pressure reading below the preoperative point. Readings were taken preoperatively on entering the operating room and at ten-minute intervals during the operation as well as at regular intervals during the convalescent period. (Fig. 5.)

The patient showed no period of diaphoresis during the reaction from anesthesia, and was taking fluids freely three hours postoperatively. The bowel was opened freely on the second day with enemas, and no abdominal distention was noted at any time. The patient was ambulatory on the fifth postoperative day.

CASE V. R. R., female, age 26 years was admitted with a ruptured ectopic pregnancy. She was first seen at her home at 3 A.M. in consultation with Dr. H. N. Calkins. Blood pressure readings at that time were 96/54, and she was in moderate shock from loss of blood into the abdomen.

She was transferred to the hospital by ambulance where she received 2 c.c. of adrenal cortex extract intramuscularly and fluids were forced by mouth. Ice caps were applied to the abdomen and the patient rested until 10:30 A.M. at which time the blood pressure was 120/74. She was prepared and taken to the operating room at 11:15 A.M. On entering the abdomen there was a free escape of dark extravasated blood, estimated to be in excess of one pint. An ectopic pregnancy was found in the outer third of the left tube, and a large cyst involving most of the left ovary. The ectopic had ruptured into the abdomen and also into the left broad ligament, where a large hematoma was present. The left tube and ovary were removed and the abdomen closed.

Blood pressure readings were taken on entering the operating room and at regular intervals throughout the entire operation as well as at regular intervals morning and evening postoperatively.

The postoperative period of convalescence was uneventful. There was no postoperative diaphoresis during the reaction from anesthesia. Fluids were taken and retained in three hours. Adrenal cortex extract was administered intramuscularly in 1 c.c. doses at twelve-hour intervals. The patient was ambulatory on the ninth day and discharged on the eleventh day. (Fig. 6.)

CASE VI. M. K., female, age 24 years, entered hospital three weeks post-partum, with acute appendicitis.

Her present illness had begun forty-eight hours previously with pain in the lower right abdomen, followed by nausea twenty-four hours later and vomiting about six hours prior to entrance to hospital. Examination on entrance to the hospital revealed marked tenderness and rigidity over the entire abdomen, but most pronounced over the lower right quadrant. Her general condition was not good, early signs of toxic shock being present.

She rested for a period of four hours. She was given 2 c.c. of adrenal cortex extract on admission and again after the four-hour rest period, following which she was prepared and taken to the operating room. On entering the abdomen there was a free escape of milky white fluid from the peritoneal cavity; the omentum was well down over the lower right quadrant of the abdomen and closely wrapped about the appendix to which it was becoming adherent. The omentum was clamped and re-

sected, care being taken not to disturb its attachment to the badly swollen and gangrenous appendix. The appendix was removed in the usual manner and the abdomen closed after two cigarette drains had been placed in the peritoneal cavity. Blood pressure readings were taken at regular ten-minute intervals in the operating room, beginning with the preoperative pressure and ending with a postoperative reading. The patient showed no signs of shock at any time and left the operating room in good condition.

*Postoperative Convalescence.* There was no period of diaphoresis during the reaction from anesthesia. The patient was taking and retaining fluids in three hours. The abdomen did not show any distention at any time postoperatively. The bowel was opened with enemas on the second day without difficulty. She was ambulatory on the sixth postoperative day and discharged on the ninth day. All drainage stopped on the sixth day and the incision was completely closed at the time of her discharge from the hospital. Complete blood pressure readings were taken at regular intervals morning and evening during the postoperative convalescent period. (Fig. 7.) Adrenal cortex was administered in doses of 1 c.c. at regular twelve-hour intervals.

CASE VII. M. R., female, age 29 years, was admitted with a diagnosis of chronic salpingitis, bilateral (pyosalpingitis) and chronic appendicitis. The patient stated that she had experienced repeated attacks of pelvic pain for the previous six years, since the birth of her last child. Her present illness had begun three weeks before, with chills and fever accompanied by pain and tenderness in the pelvis, and rigidity over the lower abdomen. She was put to bed at home and given expectant treatment by her family physician, being transferred to the hospital one week after the temperature had reached normal. Examination on entrance to the hospital revealed fluctuating masses in both lateral cul-de-sacs, the one on the left being larger than that on the right. Preoperative preparation of 2 c.c. of adrenal cortex extract was given at eleven, and at one and one-half hours before entering the operating room.

Bilateral salpingectomy, left oöphorectomy, and a routine appendectomy were done. Numerous adhesions were resected. Two cigarette drains were placed in pelvis.

*Postoperative Convalescence.* No period of diaphoresis occurred during the reaction from anesthesia. Fluids were taken and retained in three hours. The bowel was opened with enemas on the second day, and no abdominal distention was noted. The patient was ambulatory on the eighth day and discharged on the tenth day.

Adrenal cortex was given in doses of 1 c.c. at regular intervals of twelve hours during the convalescent period. The incision was healed on discharge, the last drain having been removed on the sixth day. Blood pressure readings were taken at regular intervals during the operation and convalescence. (Fig. 8.)

CASE VIII. E. P., female, age 21 years, had a thyroid adenoma. She had first noticed an enlargement of the thyroid at the age of puberty. Tachycardia had been present for the past four years. B.M.R., taken two years before, was plus 22. Medical treatment had given relief for short periods, but the tachycardia returned after treatment was discontinued. B.M.R. on entrance to the hospital was plus 25.

The patient was given preoperative medication with iodine for five days before entering hospital. On the evening of entrance to the hospital, 2 c.c. of adrenal cortex extract were given intramuscularly at 9 P.M. and repeated at 6 A.M., before the patient was taken to the operating room at 8 for a subtotal bilateral thyroidectomy.

*Postoperative Convalescence.* No period of diaphoresis was seen during reaction from the anesthesia. The patient was ambulatory on the fourth day and discharged on the sixth. Adrenal cortex extract was given in 1 c.c. doses at regular twelve-hour intervals during convalescence. Complete blood pressure records were kept during the operation and convalescence. (Fig. 9.)

#### SUMMARY

In reviewing this series of over fifty surgical cases treated with adrenal cortex extract, the following reactions have been observed:

Body electrolytes, i.e., chlorides, sodium, etc., are apparently maintained at or near normal balance.

Blood pressures are stabilized during both operative and postoperative periods, with pulse pressures maintained at or above normal levels.

Improvement is evidenced in certain cardiac irregularities; i.e., extrasystoles, chronic myocarditis, and auricular fibrillation.

Excessively rapid pulse rates have not been noted.

During the anesthesia reaction period the skin maintains a normal color, warmth and moisture with a marked absence of the usual heavy diaphoresis (obviously barring the use of heavy "ether blankets").

Deleterious gastrointestinal symptoms, i.e., nausea, vomiting, distention and gas pains, are noticeably mitigated.

The amount of narcotics needed to alleviate pain and distress is diminished.

Healing of incisions is expedited, with narrow, firm scar formation.

Accelerated recovery curtails the usually required time of hospitalization and expedites the early return to normal activity.

The above results are obtained with the use of an adrenal cortex extract which is biologically assayed for consistent strength and freedom from adrenalin.

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OPERATION on patients with obstructive jaundice offers three avenues of danger, aside from the so-called "accidents" of surgery: hemorrhage, uremia and hepatic insufficiency.

From—"Bile—Its Toxicity and Relation to Disease" by O. H. Horrall (University of Chicago).

# THE TREATMENT OF SUPPURATIVE CUTANEOUS WOUNDS AND ULCERATIONS WITH COD LIVER OIL AND ALLANTOIN

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## HISTORICAL

THE treatment of wounds has engaged the attention of mankind since pre-historic time. One of the earliest medical records in existence, the Edwin Smith Surgical Papyrus, contains a discussion of the principles to be followed in the treatment of traumatic wounds. The fact that perfection in the treatment of wounds has not yet been attained has evidently constituted a challenge to investigators, judging from the multiplicity of substances brought forward to speed up repair. Through the centuries, various vogues of wound treatment have had their evanescent sway, but no one method has survived the test of time.

The use of living maggots and insects in the treatment of osteomyelitis, abscesses and non-healing wound infections dates back to antiquity. Egyptian, Hindu and Arabian surgeons were not at all unfamiliar with the invasion by maggots of gangrenous and non-healing wounds although it is hardly likely that the medical men of old recognized the therapeutic value inherent in the maggots.

The relation of flies and maggots to disease processes is mentioned, perhaps for the first time in literature, by Ambroise Paré (1510-1590). Paré found gangrenous wounds inflicted during the Battle of St. Quentin (1557) fetid and full of maggots. He employed a recipe of young larvae boiled in oil of lilies as a dressing for gunshot wounds.

Later, in 1704, Zachmann discussed the origin of maggots in wounds, and Larrey, during the Napoleonic wars, noted the

healing effects of living maggots in the widespread suppurative wounds of soldiers. This writer was convinced that these insects accelerated cicatrization by shortening the work of nature and by producing an elimination of the necrotic cells by devouring them. He, furthermore, noted that the larvae consumed putrid material and did not disturb any living tissues.

Malgaigne (1847) mentions the use of maggots, referring to Larrey's observations. From this date, little investigative work was done with this form of therapy, until 1928 when Baer commenced the use of maggots in the treatment of osteomyelitis. However, the beneficial effect of the maggots accidentally contaminating major wounds was repeatedly noted by numerous clinicians. Crile, Martin, and others, in 1917, observed that the wounds inflicted in the World War which healed best were those containing maggots.

The therapeutic value of maggots in osteomyelitis and other chronic suppurations has been exemplified in many excellent clinical reports by Baer, Livingston, Robinson, Hewitt, Asbury and others.

## ACTIVE PRINCIPLE OF MAGGOT THERAPY

When this form of therapy was first employed, it was assumed that in addition to the mechanical action of the maggots, and the production of serum from local stimulation of the granulation surfaces, an active principle was produced which was responsible for the healing. Robinson, in 1933, conceived the idea that maggots secrete a definite substance which stimulates growth of vascular granulation, cleanses

wounds and brings about a healthy condition in the ulcerated region.

It was also suggested in 1931 (Goldstein)

group has been considered the growth stimulating agent by several writers, notably Hammett and Reimann, Kendall and

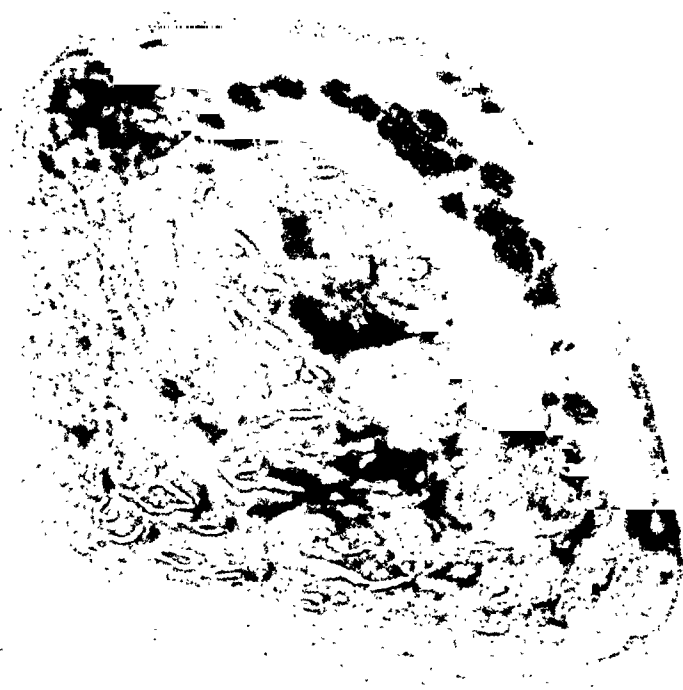


FIG. 1. Case 1. Large ulcer following removal of epithelioma a few days after institution of cod liver oil-allantoin treatment.

that an enzyme-like product produced by the maggot bodies acted as a digestant and antiseptic. The employment of an emulsion or paste of ground sterile maggots was suggested by this writer for the treatment of superficial wound infections and chronic discharging wounds and indurative ulcers. Recently, Livingston and Prince have reported excellent results in the treatment of chronic osteomyelitis and other ulcerative conditions with the use of extract of maggots. The substitution of living maggots with an extract of the larvae gave results equally as good as the use of the actual maggots.

The extract of the maggots is composed of several components each of which is claimed to be the active therapeutic factor, namely: sulfydryl, calcium, cysteine, glutathione and natural allantoin. The sulfydryl

Brunsting and associates. Stewart and others attribute the therapeutic effect to the high calcium content which, in combination with picric acid, forms chemically an active healing agent.

The extraction of allantoin from maggots and their excretions offered direct evidence of a most important active therapeutic agent underlying the success of maggot extract therapy. Allantoin has been employed unknowingly from the earliest times in the treatment of chronic non-healing suppurative wounds and burns in the form of a plant root richly laden with allantoin, known as the common comfrey (*symphytum officinale*). This plant has been recommended by ancient writers in medicine as a dressing for wounds, sores and ulcers of different types. It has received a traditional reputation among the country

folk, both in England and in Ireland, as a domestic herbaceous medicament for the treatment of ulcerative affections.

In 1912 Macalister<sup>23</sup> employed allantoin in the form of an infusion of the powdered comfrey root in the treatment of chronic indolent ulcers which refused to heal with ordinary remedies, and obtained healing effects with rapid granulation. Dr. Tetherly of the Chemical Department of the University of Liverpool, under the direction of Macalister, was the first to prove that the crystalline body he obtained from the root was allantoin  $C_4H_6N_4O_5$ . This substance may also be obtained synthetically by the alkaline oxidation of uric acid in the cold. It is also a characteristic component of the fetal allantoic secretion.

William Bramwell<sup>4</sup> likewise succeeded in curing old ulcers which had resisted treatment by other means with the simple extract from the comfrey root applied on lint to saturation. Clinical corroboration of the healing effects of allantoin in ulcerative conditions, however, was not obtained until 1935 when Robinson<sup>31</sup> determined that allantoin was a constituent of the urinary excretions of surgical maggots. This investigator tested this substance on chronic non-healing infected wounds with edematous indolent tissues. After the first few treatments, small areas of shining pink granulation tissue was found growing in the wound, followed later by a general development of healthy granulation tissue. Robinson concluded that the excretion of allantoin into the wound is undoubtedly one of the factors contributing to the remarkable healing effects obtained in maggot therapy.

Allantoin is bland, harmless and stable under ordinary conditions. It is odorless and does not stain. Since it is not antiseptic, it does not directly retard bacterial growth; hence the addition of a chemical antiseptic is generally indicated when it is used in non-sterile preparations. The substance is the principal terminal product of purine metabolism in animals below man and it results from the oxidation of uric acid.

#### THERAPEUTIC EFFECT OF COD LIVER OIL IN ULCERATION

In 1935, several articles appeared describing the therapeutic value of cod liver oil in various combinations in the treatment of cutaneous ulcers. Borovskaya<sup>3</sup> reported rapid healing in fifty-three cases of ulcerative lupus treated with an ointment containing 33 per cent cod liver oil. The bactericidal value of cod liver oil was studied in both animal and human subjects by Tumanski.<sup>37</sup> This author also observed favorable results from cod liver oil, especially in granulating wounds of the soft tissues. Drigalski<sup>7</sup> after extensive bacteriologic experimentation found that cod liver oil has a definite bacteriostatic, as well as bactericidal, action. Furthermore, he believes that the cod liver oil tends to hinder the passage of toxins from the wound into the adjacent tissues. Lundh,<sup>22</sup> in a series of animal experiments, found that only those ointments which contained a high percentage of cod liver oil tended to shorten the healing time of cutaneous ulcers. He further found that the experimental animals showed an improvement in their general condition, and attributed this betterment to the absorption of cod liver oil from the wound surfaces.

Most writers attribute the healing action of cod liver oil to its vitamin A and D content (Hayashi); others attribute this action to the fatty acids. Seiring,<sup>33</sup> premising his procedure on the observations of Dresel, who in 1927 showed that fatty acids have a bactericidal action on gram positive bacteria, treated a number of patients with certain of the high non-saturated fatty acids and obtained results similar to those obtained with cod liver oil.

Many surgeons<sup>14, 16, 28</sup> have employed cod liver oil ointment in conjunction with plaster splints in the treatment of compound fractures and in fractures complicated by infected wounds of the overlying soft tissues. The consensus of opinion of these observers is that cod liver oil has an extremely favorable effect



on healing and aids in the removal of necrotic tissue. However, it is difficult to evaluate the action of cod liver oil in these



FIG. 2. Case 1. Photograph taken ten weeks after treatment with cod liver oil-allantoin ointment. Complete healing has taken place. A small dark papule immediately external to the scarred area may be evidence of recurrence of the growth.

cases because the results depend on the entire treatment rather than on the cod liver oil alone.

In 1934 Löhr<sup>21</sup> reported that cod liver oil was remarkably effective in controlling secondary infection in burns covering extensive areas. Burns and wounds treated with cod liver oil undergo rapid cleansing and epithelization. Löhr found the cod liver oil superior to tannic acid. He employed the closed method, i.e., the cod liver oil is applied in salve form and the area covered by a plaster of Paris cast. Deeply ulcerated wounds healed rapidly under the influence of the cod liver oil and the enforced rest of the involved part. Steel,<sup>35</sup> impressed by the results of Löhr, used cod liver oil in the treatment of extensive burns. Instead of using the

"occlusive" method as described by Löhr, and also by Winnett-Orr, Steel applied the cod liver oil directly to the wound and then covered the latter with lint. The results obtained in burns of varying degree were uniformly excellent. Healing was rapid and attended by a minimum of wound infection.

#### COD LIVER OIL-ALLANTOIN THERAPY

Since the recognition of the value of maggots as a therapeutic agent in the treatment of suppurative wounds and osteomyelitis, the attention of many workers has been directed to devise a treatment which would embody the active principles of maggots but eliminate the unpleasant features and inconveniences of the maggot treatment. In the present study, we have employed cod liver oil with allantoin and phenol in a number of chronic dermatologic affections, burns, non-healing sinuses following abdominal operations, chronic ulcers, and similar conditions.

The preparation employed in this investigation consisted of an ointment with a lanolin base, containing 45 per cent cod liver oil, 2 per cent allantoin in combination with 0.5 per cent phenol.

The ointment has proved extremely beneficial in chronic, poorly granulating wounds and ulcerations of the skin; in second and third degree burns; in extensive exfoliative types of dermatitis, and in irritative skin conditions associated with pruritus. The process of epithelization is decidedly stimulated, and complete healing is accomplished in a period of time varying from a few days to several weeks in the less severe types of affections, to several months in the widespread deep ulcerative conditions.

In a previous report,<sup>9</sup> it was shown that the addition of allantoin enhances the value of cod liver oil. This was demonstrated in two cases of widespread dermatitis in which the preliminary treatment with soothing ointments containing cod liver oil and phenol did not bring about any improvement. When the combined allan-

toin and cod liver oil preparation was used, noticeable improvement, both objective and subjective, occurred in a few days,

cases of ulcer of the foot associated with diabetes; two cases of varicose ulcer; one sinus following incision of an ischiorectal



FIG. 3. Case 11. Ulcer of foot in a patient with Buerger's disease before institution of cod liver oil-allantoin treatment.

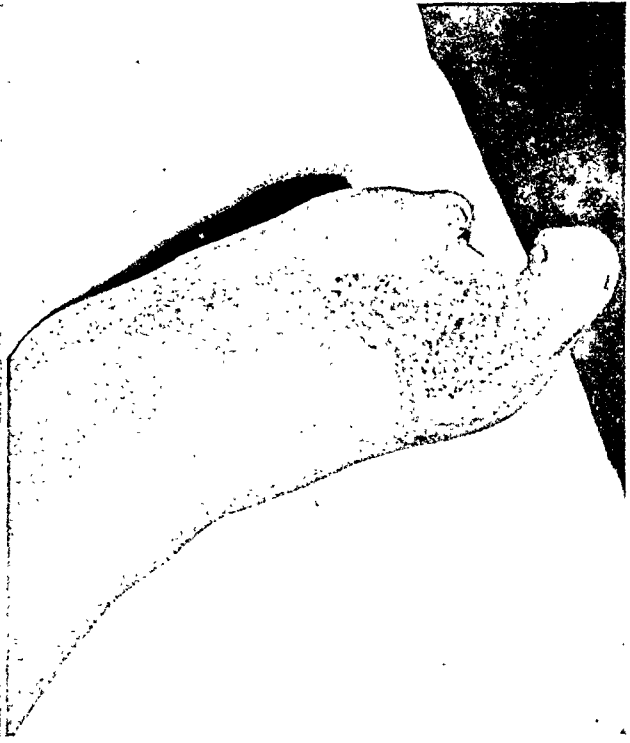


FIG. 4. Case 11. Appearance of ulcer on December 20, 1937, four months after beginning of cod liver oil-allantoin therapy. The wound is granulating and considerably smaller in size.

and was progressive until complete disappearance of the eruption within seven weeks after institution of treatment.

Applications of the ointment are made at least once a day and the part is covered with sterile gauze. The affected area must be completely covered with the ointment. In those cases where there is danger of too great an absorption of phenol, because of the extent of the lesion, the phenol may be omitted. In less widespread lesions, there is no danger of excessive phenol absorption.

The following are some of the conditions in which an ointment containing cod liver oil (45 per cent), allantoin (2 per cent), and phenol (0.5 per cent) was employed by us: one case of deep, indolent, residual ulcer following removal of an epithelioma of the back by surgical diathermy and electrocautery; three cases of non-healing sinus tracts following abdominal operation; one chronic infected ulcer of the foot associated with Buerger's disease; two

abscess; one case of osteomyelitis of the distal phalanx of finger; three cases of second and third degree burns; three cases of anal pruritus, and three cases of widespread dermatitis.

#### CASE REPORTS

Following are abstracts of the clinical histories of some of the representative cases treated in our series:

**CASE 1.** S. A. T., white male, age 78, first noticed a small verrucous growth on the mid-dorsal region of the back about seven years ago. The growth continued to increase in size and became ulcerated. He was treated with various salves without improvement. Following a course of intensive x-ray irradiation, the growth, which had been diagnosed as an epithelioma of high malignancy, began to spread rapidly. On August 28, 1937, the growth was removed by surgical diathermy followed by electrocautery. This treatment left an ulcer 4.5 inches by 3.5 inches in diameter

and extending down to the deep fascia of the back. The lesion showed little tendency to heal and on September 6, 1937, the patient

indolent ulcer of the dorsum of the foot developed subsequently. Treatment consisted of the following: left femoral sympathectomy in



FIG. 5. Case iv. Showing appearance of infected foot in patient with diabetes several days after incision. Treatment with cod liver oil and allantoin had just been commenced.

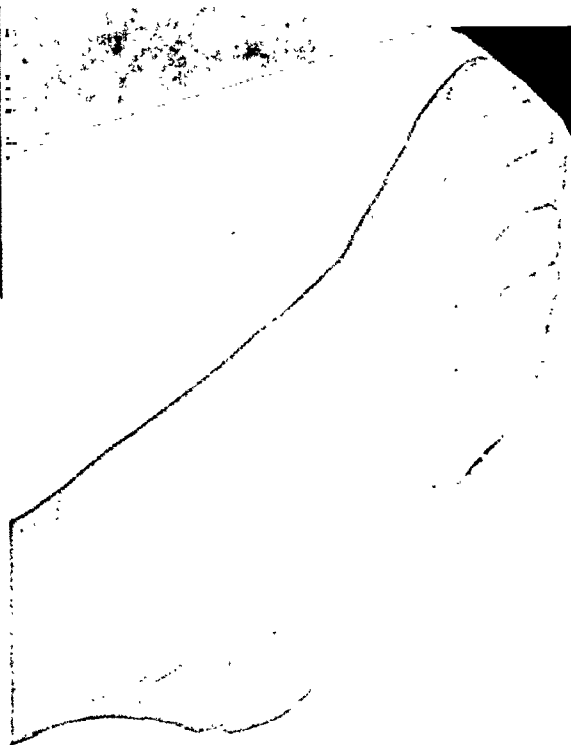


FIG. 6. Case iv. Complete healing in eighteen days with insulin and the compound ointment.

developed a severe secondary hemorrhage. Bleeding was stopped by the application of ligatures and packing. On September 9, 1937 treatment with cod liver oil-allantoin ointment was started. Improvement in the appearance of the wound was rapid. Figure 1 is a photograph of the lesion taken about a week after treatment was started and shows evidence of beginning granulation; the deep fascia is visible only in the center of the lesion. Healing continued without any secondary infection and on November 18, the entire ulcer was completely healed. No grafts were used to correct the skin defect. (Fig. 2.)

CASE II. I. G., white male, age 34, had a chronic infected ulcer of the left foot secondary to Buerger's disease (Fig. 3) of twelve years' duration. The right leg had been amputated above the knee. The left leg began to show symptoms about 1930, and the second, third, and fourth toes were amputated. A large,

September 1930; intravenous sodium citrate solution for about six years; ultraviolet light treatment for three months in 1934; passive hyperemia, concomitantly with various salves locally for about one and one-half years during 1935 to 1937. Short wave diathermy and suction pressure therapy were also used for about six months. Under none of these various treatments was any improvement of the large infected ulcer on the dorsum of the left foot seen. The surface of the ulcer continued to remain infected, grayish in appearance, and extremely indolent. In July 1937 treatment with the cod liver oil-allantoin ointment was started. Since then the surface of the ulcer has cleared up considerably. The ulcer is now covered with fairly healthy granulations and appears clean. For the first time in seven years, there appears to be some attempt at epithelization at the edges of the ulcer. The deeper necrotic areas of the ulcer have disappeared and the entire ulcer is smaller and shallower,

and appears to be healing. (Fig. 4 taken December 20, 1937.)

CASE III. I. G., white female, age 24, was

urea crystals, but showed only a slight tendency toward granulation. On July 19, 1937 she developed a fecal fistula. The wound was



FIG. 7. Case v. Appearance of sinus following cholecystomy.



FIG. 8. Case v. Complete healing in ten days with cod liver oil-allantoin treatment.



FIG. 9. Iodine burn of the buttock three days after treatment with cod liver oil-allantoin ointment was instituted.



FIG. 10. Appearance of burned area three weeks after institution of treatment with cod liver oil-allantoin ointment. Epithelization has advanced remarkably.

admitted July 7, 1937 to the Mt. Sinai Hospital with a diagnosis of pregnancy of four and one-half months' duration, complicated by perforated appendicitis and localized peritonitis. Appendectomy was performed on the day of admission, the wound being drained with two Mikulicz drains. The wound became badly infected and was treated at first with

packed with the special cod liver oil-allantoin ointment daily and showed a tendency to rapid granulation and healing. On July 26 the wound was clean and appeared much smaller. On August 10 the wound was practically completely healed and no longer discharging fecal material. On August 13 the patient was discharged with a completely healed wound.

CASE IV. Mrs. S. C., age 40, had an infection of the small toe of the right foot with lymphangitis extending over the dorsum, following the trimming of a corn. Her blood sugar was 300 mg. per 100 c.c. Incision released a small amount of pus. The patient was treated with insulin and protamine zinc insulinate. Locally, daily dressings of cod liver oil-allantoin ointment were applied. Figure 5 shows the appearance of the foot several days after the institution of codalltoin treatment; Fig. 6 shows complete healing after treatment for eighteen days. Blood sugar was reduced to 167 mgs.

CASE V. Mrs. M., age 56, had had a cholecystostomy for suppurative cholecystitis, and a sinus remained with drainage of a small amount of serum. (Fig. 7.) The sinus was surrounded by an ulcerative area whose border was lined with a few papules, and the condition was associated with pruritus. Daily dressings with cod liver oil-allantoin ointment were made. The ulcerative area filled in with pink granulation, and healing occurred in about ten days. (Fig. 8.)

#### SUMMARY

1. Allantoin, in the form of living maggots and extract of maggots, has been employed with remarkable success in the treatment of chronic cutaneous ulcerations, chronic osteomyelitis, severe burns and various dermatologic conditions.

2. Considerable evidence is available attesting to the beneficial effects of cod liver oil in the treatment of chronic non-healing wounds and chronic ulcerative affections.

3. The successful therapeutic use of cod liver oil and allantoin suggested a combination of these substances to obtain a double therapeutic action greater than the effect produced by either alone. It was found that such a combination with the addition of phenol was extremely effective in stimulating granulation tissue and encouraging healing in chronic ulcerative affections.

4. The ointment employed in this study contained 45 per cent cod liver oil, 2 per cent allantoin in a lanolin base with 0.5 per cent phenol.

5. Deep indolent ulcerative conditions and various cutaneous inflammatory affections respond promptly to applications of cod liver oil-allantoin ointment. The therapeutic procedure is simple and may be applied without any discomfort to the patient. It is tolerated better by the patient than the use of the actual maggots.

The preparation of cod liver oil-allantoin employed in this study is known as codalltoin and was made available through the courtesy of the Amfre Drug Company, New York City.

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# BENIGN TUMORS OF THE ILEOCECAL REGION\*

## WITH A SURVEY OF THE LITERATURE

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THE following case reports and discussion are presented because they are concerned with two rare types of benign tumors found in the ileocolic region: one, an ileocecal submucous lipoma discovered at necropsy, and the other, a mesenteric fibroma found at laparotomy.

### LIPOMA OF ILEOCECAL VALVE

C. K., a housewife 52 years of age, was admitted to the surgical service of Dr. Shatara of Cumberland Hospital, on September 20, 1931, suffering from severe abdominal pain.

*Present Illness.* The patient had had intense abdominal pain especially through the epigastrium, for three weeks prior to admission. In the last twenty-four hours this was associated with persistent vomiting.

*Previous History.* She had had rheumatic fever at the age of 20. Cholecystectomy was performed in December 1929, with partial relief of symptoms of abdominal pain, nausea and vomiting. At this time a palpable, smooth, mobile mass about 15 cm. in diameter was felt in the right lower quadrant by abdominal palpation and digital examination per rectum. The patient returned to the hospital four months later with a ventral incisional hernia which was treated conservatively.

*Physical Examination.* The patient was an obese white female, weighing 250 pounds, acutely ill, with a temperature of 100°F., pulse of 115 per minute, and rapid shallow respirations. The heart sounds were distant. The abdomen was obese and pendulous. A mass, which enlarged on straining, was found in the region of the abdominal scar. There was marked tenderness throughout the epigastrium. A diagnosis of incarcerated incisional hernia was made and an immediate operation was decided upon.

*Operation.* Excision of the midline scar (of previous operation) was made and the

fascia split. The intestines and omentum immediately beneath were found to be adherent to the borders of the gaping peritoneum. The adhesions were freed and the defect in the peritoneum was closed in the usual manner.

*Course.* Following operation, the pulse was 150 per minute, respirations 40, and temperature 100.4°F. About nine hours after operation the patient became restless and irrational. There was marked perspiration. The radial pulse became imperceptible, the respirations rapid and shallow and the temperature made a terminal rise to 106.8°F., the patient expiring nineteen hours following the operation.

*Post-Mortem Findings.* The heart weighed 370 Gm., having considerable epicardial fat. The mitral valve was thickened along the line of closure. The anterior leaflet showed four minute, discrete, gray, firm, semitranslucent nodules, which, microscopically, consisted of hyalinized fibrous connective tissue. The spleen weighed 360 Gm. and was soft in consistency and red in color. The liver weighed 3,220 Gm., was yellow in color and microscopically showed marked fat replacement. The pancreas similarly showed a high degree of lipomatosis. The kidneys showed arteriosclerotic changes.

The *ileocecal valve* showed a large, soft, yellow, moderately lobulated mass measuring 5 × 4 × 3 cm. attached by a broad pedicle to the lower lip of the valvula coli. (Fig. 1.) This tumor was covered with normal mucosa and protruded into the lumen of the cecum. The cut surface presented a homogeneous, finely lobulated, yellow appearance. There was another similar ovoid mass, 2 cm. × 1 cm., proximal to the main tumor. Microscopically, the structure was typical of lipoma, containing sparse capillaries and supporting connective tissue. The overlying mucosa was normal and the muscularis mucosa was partly atrophied. The lymphatic spaces of the submucosa were dilated. The inner circular layer of the muscularis was not recognized at some points. The

\* From the Department of Pathology of Cumberland Hospital.

external longitudinal muscle fibers were thin. The remainder of the gastrointestinal tract was normal.

lower quadrants. The last normal bowel movement occurred on Aug. 5. He vomited greenish material about eight hours after the onset of the



FIG. 1. Submucous lipoma of ileocolic valve.

The anatomic diagnoses were: obesity, status post-operative for incarcerated hernia, sclerosis of mitral valve (probably rheumatic), lipomatosis of liver and pancreas, nephrosclerosis, and lipoma of ileo-cecal valve. Death was probably due to post-operative shock in an obese female showing suggestive rheumatic infection of the heart.

#### MESENTERIC FIBROMA OF TERMINAL ILEUM

E. B., 42 years of age, colored laborer, was admitted to the surgical service of Dr. Chester Davidson, Cumberland Hospital, on August 6, 1935 at 2:00 A.M., complaining of severe lower abdominal pain.

*Present Illness.* The patient had had a dull, aching, suprapubic pain seven days before admission, aggravated a few days later by walking. He then went to bed where he was more comfortable when lying on the right side. During this period the appetite was good and the bowels regular. On August 5, the patient worked the entire day. At 2:00 A.M. of the next day, he was aroused from sleep by the increasing intensity of the suprapubic pain, which was continuous, aching, and radiated across to both

acute pain. At this time, he developed epigastric pain after micturition.

*Previous History.* Epidemic parotitis with orchitis had occurred at the age of 32.

*Physical Examination.* The patient was a well developed and nourished colored male, 42 years old, acutely ill, with knees drawn up. There was exquisite tenderness in the lower quadrants with marked board-like rigidity. Rectal examination revealed similar tenderness, although more marked towards the right. The temperature was 102°F., pulse 84 per minute, respiratory rate 20 per minute, and blood pressure 126/83. The leucocyte count was 6,250 with 87 per cent polymorphonuclear neutrophils and 13 per cent lymphocytes. The urine was normal. Blood Wassermann (alcoholic and cholesterin antigens) was one plus. A clinical diagnosis was made of perforated appendicitis with peritonitis and immediate surgery was recommended.

*Operation.* A lower right rectus incision, 20 cm. long was made. The muscles were split and the peritoneum opened. There was a large, ovoid, solid, tumor mass in the mesentery of the terminal ileum, the wall of which was "invaded" by the tumor and showed an area



of perforation. The peritoneum contained plastic lymph. The omentum was adherent to the mass at several points. There were no palpable

11 cm. in diameter, weighing 550 Gm. and to which was attached a segment of intestine 26 cm. in length. (Fig. 2.) The mass was firmly

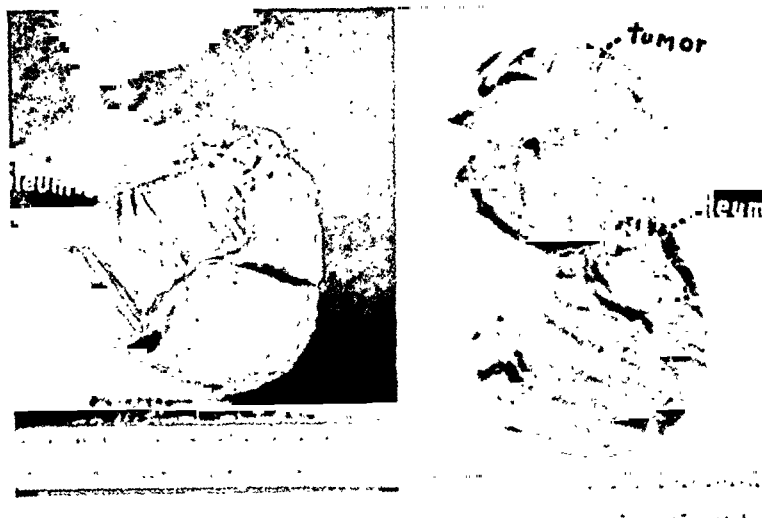


FIG. 2. Mesenteric fibroma.

nodes in the mesentery. There was a small quantity of free, purulent fluid present which showed *B. coli* on culture. The tumor and 15 cm. of the ileum were resected, the cut ends of the bowel were "purse-stringed" and inverted and a lateral anastomosis was performed. The abdomen was closed without drain in the usual manner. The postoperative clinical diagnosis was fibrosarcoma of the terminal ileum with perforation and localized peritonitis. Twenty-four hours after the operation the pulse was 128 per minute, temperature 105.2°F., respirations 12 per minute, and the blood pressure 80/64. There was improvement with intravenous and clyses of glucose. On the third postoperative day, the blood pressure was 124/80. On the sixth day, the abdomen became distended. On the seventh day, before death, the blood pressure rose to 150/100. The pulse rate increased to 150 per minute, and the temperature rose to 106°F. followed by exitus.

The post-mortem diagnoses were: generalized suppurative peritonitis, lobular pneumonia, focal necrosis of liver, surgical ileocecal anastomosis, anomalous double cystic duct and bilateral bifid ureters. (The examination of a specimen of blood taken at autopsy gave a three plus Wassermann reaction.) Death was due to postoperative suppurative peritonitis.

*Pathologic Report of Surgically Removed Specimen.* The specimen was an ovoid mass,

elastic and covered with a thin, pink-yellow glistening capsule which was continuous with the serosa of the intestine. At some points the mesenteric line was lost, due to the intimate union of the mass which appeared to merge with the wall of the gut. The intestinal mucosa showed an ulcerated area, 2 cm. in diameter with a sharp border and necrotic hemorrhagic base. This ulceration communicated with a small cystic cavity in the tumor. Microscopic examinations of sections from various areas of the mass showed a highly cellular edematous fibrous structure containing foci of leucocytic accumulations and congested vessels. The cyst wall was made up of fibrous tissue containing inflammatory cells. The adjacent intestine showed gangrenous change. A pathologic diagnosis of mesenteric fibroma and gangrene of ileum was made.

#### INCIDENCE

*Lipomata of the Gastrointestinal Tract.* The anatomic distribution of all collected cases of gastrointestinal lipomata, totaling 259, may be classified as shown on p. 541.

Although the recent literature contains numerous references to enteric lipomas with involvement of every portion from esophagus to rectum, tumefaction of the ileocecal valve is singularly rare. Comfort, in his

Esophagus.....	2
Stomach.....	31
Duodenum.....	19
Small intestine.....	68
Ileocecal region.....	9
Ileocecal valve.....	3
Cecum.....	23
Colon.....	60
Sigmoid.....	21
Rectum.....	12
Incomplete accounts.....	11

series of 181 cases, describes only two in which the ileocecal valve was the seat of lipomatous growth, and Jefferson (1920) describes a fibroma of one of the lips of the ileocecal valve.\*

*Mesenteric Fibroma.* Of 820,000 consecutive admissions at the Mayo Clinic, there were twenty-five cases of mesenteric tumors and only two were fibromata. Greer, in 1911, reviewed the literature of the preceding ninety years and collected reports of thirty-three cases. Harrison and Herzog, in 1897, reviewed some fifty-six cases, which, however, lacked histopathologic study. It is probable that most of the earlier cases reported represent curiosities of mesenteric growth and cannot be scientifically utilized for comparative study and classification. Proved cases of pure mesenteric fibromas have been reported by Royster (1911), Bevan (1918), Kyle (1921), Rawls (1923), De Courcy (1925), MacCauley (1925), Baldwin (1927), Grigorowsky (1928), Darnall (1928), Councillor (1931), Wakely (1931), Cox (1932), Summer (1932), McCalla (1932), and Weaver (1933).

*Age.* Case reports of mesenteric fibroma are found most often in adults. However, those found may have been present in childhood, without causing symptoms. Weaver, in 1933, reported a massive cellular fibroma of the mesocolon in a 10 year old colored female.

#### ETIOLOGY

*Lipomata.* There are large gaps in our present knowledge of the cause of tumors.

\* Since this survey was begun, the writer has observed another pedunculated submucous lipoma of the ileocecal valve, an accidental finding at autopsy.

There is increasing belief that several factors are involved, particularly of hormonal hereditary nature. The most that can now be definitely stated, is that a new growth is a result of developmental processes influenced by the genetic pattern of tissue development and by hormonal control through endocrine glands. The appearance of lipomatous tumors after puberty is one of many instances that suggests the influence of the gonadotropic secretion on tissue growth.

*Mesenteric Fibromata.* The origin of mesenteric new-growths is as shrouded in mystery as is the etiology of tumors elsewhere. Various theories have been suggested. The occurrence of mesenteric fibromata in the male readily weakens the hypothesis that these new growths result from detached uterine fibroids. The imperceptible merging of tumor mass and gut wall is the main factor to suggest origin from the intestinal wall. However, a more plausible and convincing explanation is that these benign neoplasms arise from segregated, mesoblastic remnants of the genital gland in the mesentery and sometimes referred to as origin in situ (from the connective tissue of the mesentery). The genital ridge develops lateral to the mesentery of the gut. From the common urogenital mesentery, the genital and Wolffian bodies derive their respective mesentery. The Wolffian duct is located in the medial margin of the genital ridge and dorsal to the müllerian duct. It is conceivable that portions of these fetal rests may migrate to the retroperitoneal tissue and invade the mesentery of the bowels and that under the influence of hereditary and hormonal factors these nuclei become the mesenteric tumors in postnatal life.

#### PATHOLOGIC ANATOMY

*Lipomata.* The lipomata may take the form of a small collection of fat cells in the submucosa, diffuse lipomatous infiltration, or discrete tumor mass. The fat cells are usually of the mature type, including the

microscopic varieties that are enclosed in the connective tissues of the submucosa. The amount and behavior of the connective tissue framework will determine the various types, i.e., fibrolipoma, liposarcoma, lipomyxoma, etc. As the tumors increase in size there is more definite demarcation between the submucosal connective tissue and the fat, the former developing into a capsule of variable thickness. Blood vessels, arterioles and capillaries are present and are normally developed. The mucosa is thinned and atrophic, although occasionally it is normal. The muscularis mucosa is not discernible in the larger tumors. Changes in the muscular layer are similarly dependent upon the size of the tumor mass as well as the degree of imposition by the tumor upon the blood supply of the gut wall.

*Mesenteric Fibromata.* Szenes collected sixty cases of mesenteric tumors which may be grouped according to the following simplified histologic basis:

Fibroma.....	25 (41 per cent)
Lipoma.....	7 (11 per cent)
Sarcoma.....	22 (39.5 per cent)
Lymphosarcoma.....	3 (4 per cent)
Endothelioma.....	2 (3 per cent)
Carcinoma.....	1 (1.5 per cent)

In this group 52 per cent are benign and 48 per cent are malignant. However, many of the latter are very likely not primary neoplasms of the mesentery. The histopathology of the primary tumors is probably determined at their early inception. Harris and Herzog (1897) refer to five cases of mesenteric tumors in children, all of which tumors were mixed types. Huge mesenteric fibromata are reported in adults, which suggest the long duration of these neoplasms. No changes occurred in the structural pattern of these new growths, the pure fibrous character of the tumors having persisted. The weight of the tumors may vary from 400 to 5,000 Gm. Baldwin (1927) described a mesenteric fibroma that weighed 11.3 Kg., which he claims is the largest ever to be recorded. Grossly, the appearance is that of an encapsulated,

round, firm, mass, white in color, the cut surface being flat and intersected with glistening bands.

Microscopically, the fibroblast is the type of predominating cell. The proportion of cells to intercellular collagen fibers varies considerably. The type with abundant collagen has a firm consistency, while the highly cellular tumors are soft and more nearly approach sarcoma. The vessels are of the mature type and are usually sparse, although definitely increased in number in the growing tumors.

Most of the fibromata develop near the mesenteric attachment. This is significant in view of the frequent intimate adhesion to the gut wall and the ease with which the new growth usurps part of the enteric vascular supply. This relative ischemia of the gut wall decreases its tissue resistance and leads to inflammatory changes varying from a mild enteritis to gangrene, with ulceration and fistula into the tumor mass. These latter changes were observed in the writer's case report. The edema associated with acute inflammation may lead to rapid enlargement of the tumor, to which the inflammation may extend by way of the perivascular lymphatic channels. In such instances leucocytic infiltration around blood vessels of the tumor is frequently described together with the other usual inflammatory phenomena.

#### PATHOLOGIC PHYSIOLOGY

*Lipomata.* The size and location of the tumor will determine the time of onset of symptoms. These are probably due to: (1) interference with the intrinsic nervous mechanism of the gut wall, causing disordered peristaltic activity, which may explain some of the symptomatology in our case; (2) obstruction of the lumen; (3) intussusception; (4) ulceration of the lining mucosa or tumor itself; and (5) results of circulatory changes incidental to forceful peristalsis or intussusception.

Intussusception is the most important complication of submucous lipomata to demand surgical intervention. This grave

event most frequently occurs in tumors of the large bowel, sigmoid or descending colon, although the small intestine, particularly the ileum, is not uncommonly similarly involved. The mechanism and dynamics of intussusception are readily explained by the "terrain malidif" produced by the tumor lying in the intestinal canal. When the enteric mass acts as a foreign body, there result spasmodic contractions of the gut around it with inhibition and relaxation of the gut immediately distal to it. The conditions are now favorable for that act of peristaltic gymnastics whereby the contracted part is induced to slip into the dilated portion. To be sure, other factors may play some rôle in this phenomena, such as the perverted muscle action due to the presence of the tumor, the paralysis of the bowel itself and the traction due to the mere weight of the tumor. Antiperistalsis may account for the cases of retrograde intussusception.

*Mesenteric Fibroma.* The location and size of the fibroma in the mesentery are the essential factors in any disturbance of the normal intestinal physiology. A relatively small growth of the mesentery near its origin may produce angulation of the duodenojejunal junction causing a long train of symptoms so commonly associated with duodenal stasis, an effect similarly produced by an abnormally high insertion of the suspensory ligament of Treitz. The intestinal sympathetic nervous supply which follows the blood vessels may be compressed upon and produce abnormal muscle action of the gut wall. By mere enlargement the tumor mass encroaches upon the lumen and causes various degrees of intestinal obstruction. Constant pressure of the new growth against the gut wall leads to anatomic union between their opposing surfaces and brings peristaltic activity at this point to a standstill, such as most probably occurred in the case reported here.

#### DIAGNOSIS

Neither enteric lipomata or mesenteric fibromata give a well defined clinical pic-

ture. Their detection must always be a matter of difficulty and their presence is not suspected until laparotomy or necropsy. It is likely that such abdominal tumors may be present for years before producing symptoms. Pollosson and Rougemont have described the following syndrome which is peculiarly associated with submucous lipomata: The patient has several attacks of abdominal pain of such severity that he remembers each attack. He suffers from borborygmi and colicky pains which come on at regular intervals. There is complete abdominal relaxation with no distention and no rigidity. The pulse and temperature remain normal. If a tumor is felt at this stage, appendicitis or a similar inflammatory condition can be ruled out, as such conditions cannot form a swelling in a few hours. Examination of the urine may help to exclude renal colic. Abdominal palpation under an anesthetic may prove to be very expedient. To be sure, with the development of obstruction or intussusception, symptoms associated with these conditions will appear.

Wardill stresses the point that in operating for intussusception in subjects over 2 years of age, a careful examination should be made of the proximal healthy bowel for possible new growth. Hubner states that in all cases where an intestinal tumor was noted, an acute intussusception was the first sign of its existence. Frequently secondary changes, such as hemorrhage, infection, and edema, bring to light the existence of a hitherto clinically silent neoplasm. Where the invagination is high up there may be no blood present in the stool.

The diagnosis of mesenteric tumor should always be suggested when there is a mobile abdominal mass extrinsic to the gastrointestinal tract and where the horizontal mobility of the tumor is greater than the vertical. Osler mentions a tympanitic zone between the tumor and the pubis. Accurate diagnosis is not of great practical importance because the unmistakable tumor calls for surgical intervention.

## PROGNOSIS

Prompt diagnosis of a tumor, regardless of the histologic structure, will tend to lower the mortality. Early surgical intervention reveals a smaller tumor mass with less likelihood of involvement of overlying intestine by intimate union with the gut wall or by usurping its blood supply. In the latter case the tumor mass may be successfully enucleated with however, subsequent development of a gangrenous process of the overlying intestine due to interference with its blood supply which was shared by both intestine and tumor. The dangers of hemorrhage, sepsis and shock are increased where intestinal resection is performed.

Generally, the mortality varies from 40 to 52 per cent, the higher percentage being associated with intestinal resections. Operative recoveries are reported by MacAuley (1925), Baldwin (1927), Fisher (1929), Councellor and Cox (1932), McCalla (1932), and Weaver (1933).

## TREATMENT

**Lipomata.** In cases of intussusception, attempts at disinvagination should be made, and if this fails, resection either of the invaginated cylinder of gut or of the whole of the infected bowel should be done with entero-anastomosis (Leclerc). Where the condition is grave, exteriorization of the affected gut is urged. Since every tumor of the intestinal tract carries with it a threat of intussusception, the propriety of complete surgical removal will be generally admitted, unless there is a definite contraindication.

**Mesenteric Fibroma.** Mesenteric tumors are ideally treated by enucleation of the tumor mass with suture of the opening in the mesentery. This is possible only in the simplest cases. The indication for a systematic primary intestinal resection is often more real than is apparent, because of the common blood supply of the tumor and overlying intestine which renders removal of the tumor impossible without

compromising the blood supply of the gut. Two factors must be considered in determining the question of intestinal resection, viz.: (1) union of tumor mass to gut wall; and (2) common blood supply of tumor and gut.

## SUMMARY

1. Two cases representing two types of benign tumors of the right lower quadrant are presented with necropsy performed in each.

2. One is a submucous lipoma of the ileocecal valve and the other a fibroma of the mesentery of the terminal ileum.

3. A brief resumé is given of the incidence, etiology, pathologic anatomy, pathologic physiology, diagnosis, treatment and prognosis in each of the two conditions described.

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# THE PROBLEM OF BLEEDING PEPTIC ULCER\*

## CLINICAL ASPECTS AND SURGICAL INDICATIONS

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THERE is general agreement that patients with uncomplicated peptic ulcer should be treated conservatively, while those who develop perforation of the ulcer or organic pyloric obstruction, and those who prove to be refractory to medical treatment, should submit to surgery. The indications for surgery in patients who have had hemorrhage are not so clearly defined. There is, in fact, considerable controversy as to just what factors must be present before this complication requires surgery.

In an attempt to obtain a clearer conception of the indications for the surgical treatment of this type of patient, a study was made of 1,025 entries of 890 patients with peptic ulcer at the San Francisco Hospital, from January 1, 1928 to December 31, 1934.<sup>1</sup> Three hundred and forty-nine patients (38 per cent) entered the hospital because of gross hemorrhage from peptic ulcer or they developed this complication during their period of hospitalization. Of this number, thirty-nine (11.1 per cent) died of exsanguination, while an additional thirteen (3.9 per cent) died of conditions associated with the bleeding, such as perforation of the ulcer, pneumonia, post-operative complications, or cerebral or cardiac thrombosis, thereby bringing the total mortality of gross hemorrhage from peptic ulcer to 15 per cent.

The incidence of hemorrhage reached its peak during the fifth decade of life, and seven-tenths of the hemorrhages occurred after the age of 40 years. The highest mortality was between the ages of 40 and 70 years, when arteriosclerosis plays a part. Of those patients who died, approximately

twice as many had duodenal ulcer as had gastric ulcer. This review further indicated that bleeding from a peptic ulcer is a poor prognostic sign and that the ulcer is likely not to remain healed permanently, probably because the majority of bleeding ulcers are on the posterior wall of the duodenum where chronicity is likely to ensue. Even though one would expect that the "death scare" of a severe gross hemorrhage would stimulate patients to follow medical instruction, nevertheless 40 per cent of these patients had had more than one gross hemorrhage. Contrary to the experience of others, the mortality from hemorrhage in our series increased with each recurrence. The pessimism of this situation may exist only in the management of patients with peptic ulcer in a city or charity hospital. The symptoms usually were relieved while these patients were in the hospital, even though penetration of the ulcer had occurred, by proper mental and physical rest as well as diet-alkali therapy. The discharge of these patients from the hospital to their more unfavorable surroundings where therapy could not be followed adequately, as well as their partaking of alcoholic beverages and excessive amounts of tobacco, often led to recurrence.

It is our belief that economic, social, and vocational, as well as constitutional or psychic factors, affect the incidence of recurrences and complications of peptic ulcer. A city hospital cares for varied groups of patients, many of whom are in poor social and economic circumstances and enter only because of complications of their ulcers. Many enter following dietary

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or alcoholic indiscretion; or their vocations are such that suitable therapeutic régimes cannot be followed. Only patients with complications of an emergency nature are admitted to the hospital. In this group, therefore, one may expect a higher incidence of and mortality from hemorrhage than are encountered in private hospitals.

Following, in general, Hinton's<sup>2</sup> plan of classifying his patients with bleeding peptic ulcer (in an analysis of 123 patients from his service at the Bellevue Hospital), we divided our cases into six groups for study. By such a study we hoped to evaluate each case—thereby suggesting the type of treatment—and at the same time, to analyze the type of patient who enters our city hospital.

Our six groups are composed of:

I. Patients with hemorrhage occurring during competent medical treatment.

II. Patients previously operated on for an acute perforation or chronic ulcer, but without hemorrhage for months or years following operation.

III. Patients who had been operated on previously for hemorrhage and who continued to have hemorrhage.

IV. Patients with severe hemorrhage but with either no history of peptic ulcer or a history of gastroduodenal symptoms of less than six weeks' duration; most of these patients did not know they had ulcers until hemorrhage occurred.

V. Patients admitted with hemorrhage and a long history of symptoms of ulcer, who were not following therapy at the time of onset of the hemorrhage.

VI. Patients with gross hemorrhage associated or coincidental with perforation.

Group I consisted of four patients, or 1.1 per cent of the 349 patients with hemorrhage. In the hospital records of only these four was there a statement that the patient was following proper or prescribed diet-alkali therapy at the time that the original hemorrhage took place. Many were under competent medical care, but deviation from their usual régime preceded the onset of bleeding. This finding is similar to that in

perforation, in that the latter complication rarely occurs in patients who are following adequate diet-alkali therapy, and suggests that ulcers producing either hemorrhage or perforation are both active and spreading. Because of the location of bleeding ulcers on the posterior wall of the duodenum or the lesser curvature or posterior wall of the stomach, hemorrhage occurs as a result of erosion of the left gastric or superior pancreaticoduodenal artery, or branches of these arteries, which supply these areas. Rapidly penetrating ulcers on the anterior wall of the stomach or duodenum, especially in proximity to the pylorus, are likely to perforate into the free peritoneal cavity rather than to cause hemorrhage. An ulcer which causes gross hemorrhage, therefore, might be considered analogous to a perforated ulcer, but, because of anatomic differences, bleeding ensues. There were no deaths in Group I.

The small number of patients on adequate treatment at the time of hemorrhage suggests the absence of medical supervision or a lack of coöperation by the majority of the patients studied.

It is natural to conclude that, if a patient is following complete and adequate therapy during the same time that the hemorrhage occurs, surgical treatment, with removal of the ulcer if possible, should follow as soon as the patient's condition permits.

Sixteen per cent of Hinton's patients fell into Group I. The discrepancy noted in comparing our series with his (Table I) may

TABLE I  
INCIDENCE OF BLEEDING PEPTIC ULCER  
BY CLASSIFIED GROUPS

Group	Percentage (San Francisco Hospital—349 Cases)	Percentage (Hinton's Cases 123, at Bellevue)
I	1.1	16.0
II	6.4	12.0
III	6.5	5.0
IV	21.4	18.0
V	62.4	49.0
VI	2.0	

result from the difference between the well developed out-patient or follow-up system used at his hospital and the lack of follow-up care or out-patient department at this hospital until very recently. Most of the patients who were discharged from this hospital previously were not heard from again, nor did they visit the other out-patient clinics in the city, as advised, until a complication developed.

*Group II.* Twenty-two patients (6.4 per cent of the entire number with hemorrhage) had been operated on previously for acute perforation or chronic ulcer, but had not bled until months or years later. Eleven, or 50 per cent, had had gastroenterostomy; eight had had perforation of an acute ulcer, with simple closure or pyloroplasty; one had had a Devine exclusion operation; one had had a pyloroplasty; and in one the type of operation was not known. Five, or 22.7 per cent, of the patients in Group II died. This evidence strongly suggests that indirect operations such as pyloroplasty or gastroenterostomy for duodenal ulcer may not protect the patient against subsequent hemorrhage or recurrence. Twelve per cent of Hinton's cases fell in Group II. He felt that, if the patient had had two hemorrhages, gastric resection with removal of the ulcer if possible, would usually become necessary. Our experience bears out his conclusion. The following is a synopsis of a typical case from Group II:

A man 63 years of age had a history of peptic ulcer dating back eighteen years. At the onset he was hospitalized and treated for duodenal ulcer, but after relief from his symptoms he was discharged from the hospital. Two years later a posterior gastrojejunostomy was done because of the recurrence of symptoms. Some fifteen years after his gastrojejunostomy, he entered this hospital because of recurrence of symptoms followed by hemorrhage. At this time a gastrointestinal x-ray series revealed a duodenal ulcer and a poorly functioning gastrojejunostomy. Following diet-alkali therapy, he again was relieved of symptoms and was discharged from the hospital with the advice that he follow a modified Sippy régime. He followed the therapy

for only a short time, and about a year later he noted recurrence of symptoms. On the day of entry, for the first time, he vomited three pints of liquid and clotted blood, passed unchanged blood in the stool, and lost consciousness.

The skin and mucous membranes were moderately pale. The blood pressure was 90/50 and the pulse rate 88. Hemoglobin was 70 per cent, red blood cell count 4,080,000 and white blood cell count 14,300. He continued to have tarry stools, and the hemoglobin, red blood cell count, and blood pressure dropped. Six days later he had a sudden severe hemorrhage by rectum, and expired. Autopsy revealed an ulcer on the posterior wall of the duodenum, with a partially thrombosed arteriosclerotic vessel in the crater. This artery was a branch of the superior pancreaticoduodenal artery. There was no evidence of gastrojejunal ulceration.

*Group III.* Twenty-three, or 6.5 per cent of the entire number of patients, had gross hemorrhage after having been operated on for a previous hemorrhage. Nineteen of the twenty-three patients had had gastroenterostomy performed originally. Subsequent hemorrhage was treated by gastric resection in one patient and a Devine exclusion operation in another, with recurrences of the hemorrhages later. One had had a partial gastric resection for duodenal ulcer originally, and later bled. It is probable that the ulcer was not removed. In three patients, laparotomy had been done following hemorrhage from peptic ulcer, but the type of operation could not be determined. Three, or 13 per cent, of the patients in Group III died in the hospital. The percentage of patients in this group compares closely with that in Group II, suggesting that a recurrent ulcer may cause hemorrhage because of its location and proximity to a large blood vessel, even though hemorrhage had not been a feature before the original operation. It also suggests that gastroenterostomy may not protect a patient against the recurrence of a duodenal ulcer or against subsequent hemorrhage. In none of these cases was there evidence to suggest that the bleeding was from a marginal ulcer. Hinton reported that 5 per cent of his patients fell



into this group, most of whom had had gastroenterostomy.

Our policy regarding this group is similar to that followed in Group II because we believe that the incidence of recurrent hemorrhage will be lessened if the ulcer, with the distal part of the stomach, is resected. If the ulcer is on the posterior wall of the duodenum and infiltrates the pancreas, thereby making resection of the ulcer and the closure of the duodenal stump hazardous, the ulcer is left, its vessels are ligated and a subtotal gastric resection is done.

Group III is exemplified by the following report of one of our patients:

A man, 55 years of age, had had four entries into the hospital within two years. On his first entry a diagnosis of hemorrhage from a duodenal ulcer was made. After his condition had improved, an anterior gastroenterostomy with jejunojunostomy was done. He was placed on a modified Sippy régime. Gastrointestinal x-ray series revealed a functioning stoma, and he was discharged from the hospital. He had several additional attacks of gastrointestinal bleeding, with tarry stools. For three months before his last (i.e., fifth) entry, he had noticed weakness, loss of weight, and epigastric pain occurring from two to three hours after meals, partially relieved by diet and alkali. Because of an attack of dizziness, hematemesis and melena, he entered the hospital.

The skin and mucous membranes were somewhat pale, the blood pressure was 130/80, and the pulse rate 92. There were no abdominal findings. Hemoglobin was 40 per cent and the red blood cell count was 1,190,000. Gastrointestinal x-ray series showed a functioning stoma without evidence of ulceration, but with a persistent defect in the duodenal cap. A diagnosis of recurrent duodenal ulcer with hemorrhage was made. The patient was placed on a modified Sippy régime, and later was discharged from the hospital, improved. A recurrence of his hemorrhage caused his death two months later at another hospital.

**Group IV.** Seventy-five patients, or 21.4 per cent, comprised this group, all of whom had either no history, or a very short one, of gastric symptoms. There were

seventeen deaths, a mortality of 22.6 per cent, the diagnosis being confirmed by the coroner in the majority of cases. Hinton reported twenty-two cases in Group IV, an incidence of 18 per cent in the entire series, with a mortality of 53 per cent.<sup>3</sup> Many of our patients in this group died within a few hours after entry and most of them were in severe shock when seen first. Almost all of them were in the arteriosclerotic age. They were in such poor general condition that only a brief history could be obtained. In certain instances complete histories were obtained later. In some, symptoms of ulcer were found to have existed years previously, thereby placing these patients in Group V.

It is in Group IV that the diagnosis of peptic ulcer as the cause of the hemorrhage must be differentiated from hepatic cirrhosis, splenic anemia, gastric carcinoma, blood dyscrasia, toxemia with acute gastroduodenal ulcerations, and a few other rare conditions. The absence of any antecedent history of peptic ulcer makes the diagnosis difficult except for the fact that peptic ulcer is by far the most common cause of hematemesis. Bulmer<sup>4</sup> reported gastroduodenal ulcer as the cause of hematemesis in 88 per cent of 649 cases of hematemesis, so that, if one can eliminate hepatic cirrhosis and splenic anemia or other diseases of the blood, the percentage of diagnostic error will be very small.

It is for this group of patients more than for any other that donors should be available immediately and transfusions of from 250 to 300 c.c. of citrated blood be administered slowly. Procrastination may prove tragic because death may suddenly take place. Immediate surgery is likely to be futile during the acute bleeding phase in this particular group because of the poor general condition of the patient. Most of these patients have not been aware of their ulcers and, if they recover from the hemorrhage, they should be given a trial on medical treatment; usually they improve.

The following report is typical of patients in this group:

A man 68 years of age suddenly collapsed on the floor two days before entry to the hospital; he lost consciousness and passed a large black stool. The next day the same thing occurred, associated with the vomiting of a large amount of blood. Two weeks before, he had had rather sharp epigastric pain occurring from one-half to one hour after meals, relieved by food and soda. He had had no previous history of peptic ulcer or hemorrhage.

The patient was pale and hyperpneic, with a blood pressure of 80/60. He appeared rather anxious and was thrashing about. The hemoglobin was 35 per cent and the red blood cell count 1,200,000. He continued to vomit bright red blood and had a large involuntary black stool. He died three hours after entry, before a blood donor was procured, and the coroner's report noted the presence of a duodenal ulcer with an open sclerotic artery in the crater.

*Group V.* This group is the largest and comprises 218 patients, or 62.4 per cent of those with hemorrhage. There were twenty-five deaths, a mortality of 11.4 per cent. This group was also largest in Hinton's series, making up 49 per cent of his patients with hemorrhage, with a mortality of 10.5 per cent.

All of our patients in this group had had symptoms for more than six weeks before entry, most of them knew that they had peptic ulcer, and many had had several hospital entries. Either lack of medical supervision or of coöperation by the patient probably explains the size of this group. It illustrates the necessity for adequate therapy and close observation over a period of many years. Of the 135 patients reëntering this hospital during the seven-year period, the majority fall into this group. It is probable that many left this hospital and entered others when hemorrhage or recurrence took place. An index of their lack of coöperation is the fact that, of 193 patients in this group discharged from the hospital, thirty-six, or 18.6 per cent, signed releases, indicating that they felt further therapy to be unnecessary. The prompt relief of their symptoms brought about by rest in bed, hospitalization, diet-alkali therapy, and antispasmodics gave them such a false

sense of security that 18.6 per cent of these patients left the hospital contrary to the advice of the medical staff. The mortality and the economic loss to the patient and the community can be curtailed as soon as patients are educated to know that they will be subject to recurrences as long as they live, and that gross hemorrhage, as well as perforation, is rare in patients following adequate therapy.

If arteriosclerotic patients in this group, over 40 years of age, continue to bleed under adequate medical therapy, including transfusions, surgery should be considered in order to prevent death from exsanguination. Because we know that patients in this group are likely to continue in their own way after being on an ulcer régime for a short time after discharge from the hospital, we advocate surgery after the occurrence of two hemorrhages.

Illustrative of this group is the following rather typical record:

A patient, 28 years of age, six years before entry to the San Francisco Hospital, developed epigastric burning which occurred two hours after meals and was relieved by food and soda. A physician diagnosed a peptic ulcer and put him on a diet-alkali régime. Shortly afterward, hematemesis of one pint of dark blood, followed by tarry stools and dizziness occurred. He was hospitalized and a diagnosis of ulcer was made by x-ray. He remained on a diet for nine months, then deviated from it and had another hemorrhage. At this time he entered Boston City Hospital, where x-ray examination revealed a duodenal ulcer. He continued to have periods of remissions and exacerbations, with a recurrence of hemorrhage three years before entry to our hospital. He followed a modified Sippy diet of his own selection for some time. Two months before entry his pain recurred and because of hemorrhage, he finally entered the hospital. Examination of the abdomen was negative except for slight tenderness to the right of and above the umbilicus. The hemoglobin was 56 per cent and the red blood cell count 3,050,000. Tarry stools were present. Gastrointestinal x-ray series revealed a duodenal ulcer. Under a Sippy régime, his bleeding stopped and he was relieved of symp-

toms. At the patient's request, he was later discharged from the hospital.

*Group VI.* This group includes seven patients who had two serious, dramatic complications of peptic ulcer, namely perforation and hemorrhage, during the same hospital entry. This comprised an incidence of 2 per cent of the whole series, and there were six deaths—a mortality of 85.7 per cent. Only two of these patients were operated on, the others being almost moribund on entry. Although there is a common impression that bleeding ulcers do not perforate and perforating ulcers do not bleed, these sequences occurred in seven patients. In cases of perforation, the duodenal ulcer usually is on the anterior wall and many times is associated with a "kissing" ulcer of the posterior wall which may be the site of a hemorrhage from the superior pancreaticoduodenal artery. This has occurred postoperatively after the site of perforation has been closed by suture. Patients may have a gastric as well as a duodenal ulcer, with hemorrhage of one and perforation of the other. The other type is the bleeding ulcer located in the posterior wall of the duodenum, which, because of its active progression, spreads and involves the intraperitoneal anterior wall, through which perforation occurs. Occasionally multiple, rather acute gastric ulcers form during the progress of an acute infection and present complications of hemorrhage and perforation.

This group is exemplified by the following record:

A man, 59 years of age, entered the hospital complaining of gastric distress following meals, of a year's duration. Two days before entry, he developed rather sudden pain in the epigastrium, which became generalized. The pain gradually disappeared the next day, but he entered the hospital. At that time his epigastrium was rigid and there were no palpable masses. The hemoglobin was 88 per cent and the red blood cell count was 4,100,000; the white blood cell count was 15,000. Immediately following entry, he developed severe hematemeses and melena. Because of his poor condi-

tion, he was treated conservatively. His bleeding continued, however, and he expired three days later. At autopsy, an ulcer of the lesser curvature of the stomach was found, measuring 2 cm. in diameter. There was a large vessel projecting into its lumen. In the same region, there were also multiple small ulcers, one of which had perforated, causing a localized peritonitis.

#### SUMMARY

1. In a city hospital where patients with peptic ulcer enter only because of some serious complication of ulcer, there is a high incidence of hemorrhage and resultant mortality. In our experience, this is greatest during the arteriosclerotic age. The mortality rises with each hemorrhage.

2. This study suggests that the occurrence of hemorrhage, similar to that of perforation, is rare in patients following prescribed or proper diet-alkali therapy. In the majority of cases, dietary or alcoholic indiscretion precedes the onset of these complications.

3. Although one must treat each patient according to the merits of his individual case, based on the age of the patient, the presence of arteriosclerosis, the location of the ulcer and the past history, the data collected suggest that indications for surgery may be present in each clinical group as follows:

- (a) In the few patients who are following adequate treatment at the time of the onset of the hemorrhage (Group I), surgical treatment should be considered during the quiescent stage.

- (b) If surgery is performed for the bleeding type of ulcer, direct attack on the ulcer with its removal, in addition to subtotal gastrectomy, is the procedure of choice and is more likely to reduce the incidence of hemorrhage after surgery. The study of Groups II and III suggests that gastrojejunostomy may not protect against the recurrence of or subsequent hemorrhage from a duodenal ulcer. Thirty patients of this series had gross hemorrhage from ulcer after gastroenterostomy.

(c) Patients with no history of peptic ulcer, or a very short history, who suddenly bleed (Group iv), have the poorest prognosis for life in the entire series. Transfusions are important in the treatment of this particular group. Surgery is not feasible in the acute stage because of the patient's poor general condition. After the hemorrhage has ceased, these patients usually do well on medical treatment.

(d) Sixty-two per cent of the patients with hemorrhage have had the symptoms of ulcer for many years and, in our experience, represent an uncoöperative group (Group v). If, during the acute bleeding phase, hemorrhage keeps recurring while the patient is under medical treatment, with transfusions, immediate surgery should be considered. After the occurrence of two hemorrhages, surgery is indicated during a quiescent period because it is very likely that these patients will not follow prescribed therapy over a long period of time, and the hemorrhage will

recur. Conservative treatment is indicated in those patients below the age of forty years, without arteriosclerosis.

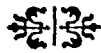
4. Hemorrhage and perforation occasionally are associated or coincidental; the prognosis is poor.

#### CONCLUSION

Indications for the surgical treatment of peptic ulcer with gross hemorrhage should be based on the age of the patient, the number of hemorrhages, the presence of arteriosclerosis and a study of the clinical aspects of each case.

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# CHOLECYSTECTOMY (SUBSEROUS) WITH CYSTIC DUCT DRAINAGE AND CHOLANGIOGRAPHY

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IN this paper we are reporting a series of 213 cases of chronic cholecystitis, with and without stones, in which the gall-bladder has been removed subserously and cystic duct drainage instituted. One death occurred in the series.

For the past fourteen years we have been doing all cholecystectomies subserously where possible and leaving a tube firmly tied in the cystic duct or in the serous sac after removal of the gall-bladder. This tube remains until the ligature dissolves. We have had three cases in which the tube was pulled out by the patient in forty-eight to sixty hours, but no harm has ever resulted. The average time for the ligature to dissolve or the stump of the duct to separate is approximately six days.

The gall-bladder is removed subserously and a No. 12 or 14 French catheter is anchored in the cystic duct with No. 1 plain catgut.

Subserous resection was first reported by Doyen,<sup>1</sup> but no one advocated cystic duct drainage as a routine procedure until 1926.<sup>2</sup> Albert Ochsner<sup>3</sup> of Chicago suggested it, but failed to advocate fixing a tube in the cystic duct for the purpose of washing out the common duct and facilitating bile drainage of the liver and biliary tree. In 1921, Reid and Halstead<sup>4</sup> advocated draining the common duct through the stump of the cystic duct, but their procedure was different from the one we use.

Drainage of the bile ducts tends to keep down bile pressure and prevent leakage through bile capillaries from raw surfaces left by dissection, thus acting also as a safety valve. If lipiodol is injected into the biliary system of a dog following the stripping of the gall-bladder from the liver

surface, it is frequently demonstrated to the eye; if the abdomen is closed, it is clearly visible on the x-ray film. (Figs. 7 and 8.)

By carefully separating the serosa from the gall-bladder as far down as is easily accomplished and loosening and drawing out the cystic duct, the common duct can be brought into view. If there is a stricture or a small stone in the cystic duct, the latter is more easily broken or pulled off, but even should a break occur from traction, no harm is done. As much as the cystic duct as possible is cut away as close to the common duct as 1 cm. or more. A large tube is then placed in the serous sac as far down as it will go and ligated securely in place by passing a No. 1 chromic gut suture around the serous coat of the gall-bladder, a mere pocket, since the gall-bladder has been removed. Drainage is copious for two to five days and the patient seems as well off as in cases where the tube is fastened in the cystic duct. If there is no evidence of stone or stricture, the common duct should not be opened.

When the cystic duct tube is fastened in place, 20 to 40 c.c. of warm magnesium sulphate solution is slowly injected into the bile ducts through the tube fastened in the cystic duct. If there is common duct obstruction from stone or stricture, the patient will complain of pain when 3 to 5 c.c. of the solution has been injected. This test, obviously, is of value only in cases operated on under local anesthesia.

Ninety per cent of our gall-bladder and duct surgery is done under local anesthesia (spinal is never used). A general anesthetic is employed only in rare cases of multiple and firm adhesions with the stone imbedded

in the ampulla, or in extremely nervous people with adhesions and stones requiring transduodenal removal. The technique of

steady traction will cause the diaphragm to exert an almost steady pressure sufficient to push the liver and gall-bladder



FIG. 1. First film, Case 1, made with the patient in supine position. This shows very plainly an indentation at the bottom, clearly indicating an obstructive object in the common duct with at least part of the surface oval, which would be interpreted as a large stone in the common duct near the duodenum.



FIG. 2. X-ray of same patient taken in the erect position. The small tube can be seen and the point where it is attached to the duct. These two films were taken five days after the operation.

local anesthesia is easily acquired. Farr is still the authority regarding the procedure and nothing worth-while has come to our attention since his last authoritative text.<sup>5</sup> In our series of 213 cases, 187 were done under local anesthesia.

When the gall-bladder is grasped in a clamp and brought up, a needle is carefully introduced beneath the serosa and from 40 to 60 c.c. of  $\frac{3}{4}$  per cent novocaine is introduced. This serves two purposes. It separates the serosa from the gall-bladder and reduces the abdominal reflex tension. The gall-bladder has no sensory fibers, and if traction is not exerted the patient will not complain. After the injection is made,

downward and afford adequate exposure for good work.

Contraction of the sphincter of Oddi (or the muscular coats of the duodenum) can be relaxed by the introduction of magnesium sulphate. When the solution is first introduced, there is marked pylorospasm; the pyloric sphincter can be seen to contract and the entire area gives an impression of hard muscular contraction. Usually the patient complains of pain when the contraction starts, but this is immediately followed by a free flow of bile back through the cystic duct tube. The pyloric sphincter relaxes in a few minutes and in many cases the patient vomits bile. The output of bile is often so profuse that it forms a thin

stream from the cystic duct tube for several minutes.

Thirty-four per cent of our cases have

We have occasionally removed the gall bladder, collected the bile through a tube, and reintroduced it by way of a duodenal

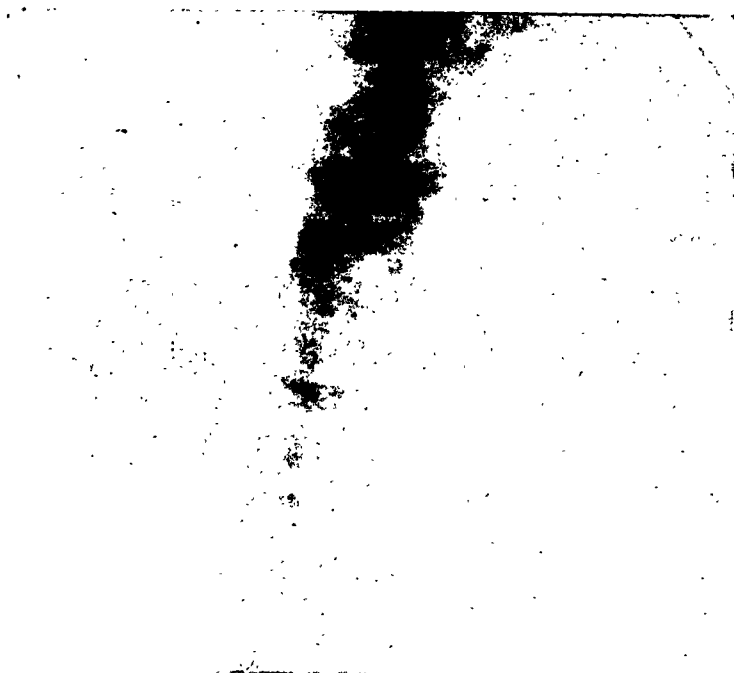


FIG. 3. Case 11. Taken with the patient on the operating table. Shows the lipiodol filling the common and hepatic ducts and the lower portion of the gall-bladder below the ligature.

shown stones in the gall-bladder and ducts, 8 per cent having common duct stones.

The use of routine cystic duct drainage affords a simple and easy method of making a radiograph of the ducts after removal of stones and any other pathologic conditions requiring surgery. After passing magnesium sulphate solution or sterile physiologic saline through the tube fastened in the cystic duct to detect leaking points, lipiodol is introduced in the same manner. A sterile sheet is spread over the operative field and the portable x-ray is used to take the necessary films. A ten-minute period is usually sufficient to develop the film and return it.

Cutting down on stones in the common duct is a hazardous procedure for the most experienced surgeon and should never be attempted by the casual operator. We cannot agree with some of our colleagues (e.g., Walters<sup>6</sup>) that "if a patient can stand a gall-bladder operation of any kind he can stand to have the common duct explored."

tube. This procedure enables the patient to regain weight, brings the icteric index down to normal and converts a poor or fair to a good risk. We report one such case as a typical example:

CASE I. Mrs. B. (Reg. No. 26180) presented herself with a history of intermittent jaundice, chills and fever of eight months' duration. She gave a history of having had a cholecystotomy eight years ago, but no stones were found at that operation. She had lost 47 pounds since the onset of her illness. The icteric index was 60.

On October 10, 1936, cholecystectomy was performed, and stones were found in the gall-bladder and common duct. The patient complained of pain when only a few c.c. of magnesium sulphate were injected through the cystic duct tube, and we were positive that a stone had lodged in the common duct. Her condition would not permit opening of the common duct, however. Improvement was rapid and she was sent home. She collected the bile from the cystic duct tube and took it each day through a duodenal tube. A cholangiogram

at this time showed an obstruction of the common duct, probably stone. (Figs. 1 and 2.)

A third operation was done on November 10,

occasional jaundice. The icteric index at this time was 12, the blood count slightly elevated, and the urine negative. A preoperative diag-



FIG. 4. Shows the lipiodol outside of the biliary tree in the duodenum as a large round shadow on the plate. This patient had a typical history of stones, including chills, jaundice, etc., but at operation no stones were found. No x-ray was made prior to operation. The case was an acute obstruction and a very typical one. If there was a stone present it was washed out by the pressure of the lipiodol and does not show on the film.

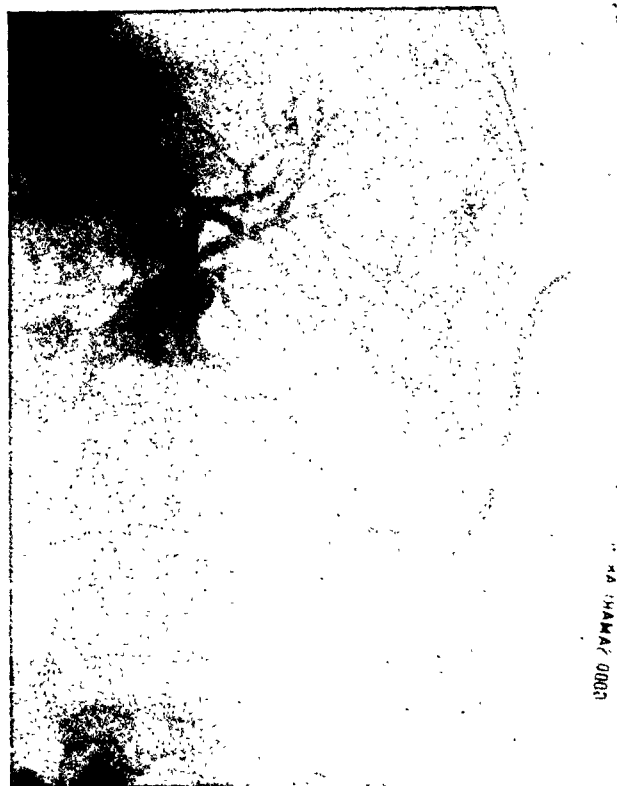


FIG. 5. Case III. Radiograph showing stone in common duct producing complete obstruction. Note concavity of lipiodol shadow at point of obstruction.

1936, at which a soft stone about 1.5 cm. in diameter was removed transduodenally from the common duct at the ampulla of Vater. She made an uneventful convalescence, and when last seen (December 15, 1936) had gained 15 pounds and was in excellent health.

Had operative interference been carried out in this case to the completion of the operation, it is our opinion that this patient would have died on the table or shortly afterward.

Cases of intermittent fever and jaundice are usually indicative of common duct stone, although the stones are frequently observed in the cystic and hepatic ducts or in the gall-bladder instead. However, there are cases, such as Case II, in which, in spite of such symptoms and signs, no stone is present. Our records show several such cases.

CASE II. W. T. B. (Reg. No. 48956) presented himself with a history of recurrent attacks of epigastric discomfort, colic, fever, and

nosis of cholelithiasis and stones in the common duct was made.

Subserosal removal of the gall-bladder was done, and lipiodol was injected into the biliary tract through a catheter in the gall-bladder while patient was on the operating table. (Fig. 3.) Another radiograph, five minutes later, showed lipiodol in the duodenum, with no indication of stones in the common or hepatic duct. (Fig. 4.) No stones were found and the common duct was not opened. The patient made an uneventful recovery and is in excellent health at the present time.

CASE III. Mr. J. A., age 50 (Reg. No. 27117), had a history of gall-bladder trouble over a period of several years. He had had hypodermics on two occasions for epigastric pain, apparently gall-bladder colic, but had never been jaundiced until the onset of his present illness. Two weeks before his entrance into hospital, the patient developed jaundice which gradually increased, accompanied by abdominal pain, fever and two slight chills. Preopera-



tive treatment in the hospital did not lower his icteric index, which at the time of operation was 75.



FIG. 6. Dog #8. The tube and the duct were fastened together by passing the tube into the gall-bladder as far down as it would go and then ligating it. The common duct was filled with small stones by passing them in through the ampulla of Vater. The common duct was occluded at the duodenum by grasping in the forceps, and the gall-bladder and duct were pulled upward, leaving the common duct in the straight line. The lipiodol is seen as round, shot-like bodies between the irregular stones.

A cholecystectomy was done January 8, 1937 and cystic duct drainage carried out. Many stones were present in the gall-bladder, and a cholangiogram on the operating table showed an obstruction of the common duct. However, the patient's condition would not allow further operative procedures.

The material contained in the gall-bladder was clear, with no evidence of bile pigments. Bile was flowing from the cystic duct tube before the patient left the operating room, and approximately 200 c.c. drained during the first three postoperative days, after which there was no further flow. Within thirty minutes time following the injection of 20 c.c. of whole blood into the liver, bile began to flow copiously from the cystic duct tube and continued to flow thereafter. Practically all the bile the liver secreted (about 900 c.c. per day) came out

through the cystic duct tube. The patient preferred to drink the bile recovered from the cystic duct tube rather than swallow the duodenal tube; this was continued until the icteric index was 10.

A second operation was performed February 9, 1937, at which time a stone impacted at the ampulla of Vater (Fig. 5) was removed trans-duodenally. He made an uneventful recovery except that bile did not enter the duodenum until two weeks later due to swelling around the operative site. As shown by subsequent cholangiograms, this partial occlusion has since disappeared and the patient has gained 12 pounds in weight.

We have reported only these three cases since they are clear cut and illustrative of the value of cholangiography.

Cholangiography is a clinical aid not only at the operating table but also post-operatively in determining the cause of persistent biliary fistulae. It is our opinion that this diagnostic test should become extremely useful and prevent many damaging and fatal procedures in gall-bladder and hepatic duct surgery.<sup>7</sup>

By the practice of cystic duct drainage and the routine washing of the ducts with warm saline or magnesium sulphate solution we have not, to our knowledge, left unrecognized any obstruction in the common duct. Stones in the cystic and common ducts below a stricture of the cystic duct are frequent enough to give abdominal surgeons cause for worry. When we cannot pass fluid freely into the duodenum through the tube, we proceed immediately to extend the operative procedure if the patient's condition will permit. The injection of lipiodol into the cystic duct drain tube makes possible location of the stricture or stone. If the patient's condition warrants it, the operation is completed.

The free passage of bile or magnesium sulphate into the duodenum is not proof in all cases that small stones do not remain in the common duct; the flow of bile past such stones is too common and well known to need discussion. Cholangiography with lipiodol will, however, detect even such small stones.

The detection in the common duct of stones which do not obstruct and cannot be palpated is at present, therefore, possible

opening the common duct in many cases. It will also detect stones in the hepatic ducts that might be easily overlooked if



FIG. 7. Dog #3. Escape of lipiodol from surface of liver slightly torn by removal of gall-bladder.

by two methods only. One is to open the common duct in all stone cases, but this may fail in cases where the stone is dislodged backward into the hepatic ducts. As a general rule, the surgeon opens the common duct only if stones have been found in the cystic duct or the gall-bladder. As mentioned before, small stones may have passed into the common and hepatic ducts and a stricture may have formed above in the cystic duct. This makes it mandatory for the surgeon to open and explore the common duct in all cases with a history of intermittent fever in gall-bladder disease, all cases of stone, and in all cases of cystic duct obstruction interfering with the free passage of fluid through the bile ducts to the duodenum.

The second method of detection, cholangiography, will obviate the necessity of



FIG. 8. Radiograph of same dog as in Figure 7 a few minutes later. Note lipiodol at site of gall-bladder and, lower down, cluster of droplets that have escaped from torn surface of liver.

merely a direct exploratory incision of the common duct were made.

In order to devise a method of demonstrating the presence of stone in the common and hepatic ducts, we proceeded to perform a series of experiments on dogs. We introduced stones of various sizes into the bile ducts, ligated the common duct near the duodenum, and then introduced a catheter into the lower segment of the gall-bladder. The bile ducts were clearly outlined by the slow injection of 3 to 5 c.c. of lipiodol, small definite areas of lessened opacity indicating presence of stones. (Figs. 6, 7 and 8.) We prefer lipiodol because of the density of the shadow and also for the very important fact that it will not injure the patient should it enter

a vein or escape through bile capillaries or aberrant ducts<sup>8</sup> into the peritoneal cavity. Should it escape, it will appear as shot-like bodies, warning the surgeon that there is bile leakage due to the stripping of the gall-bladder from its bed or to a damaged duct. (Figs. 7 and 8.) The more dense the medium, the clearer the outline of the stone will be, except in the case of such stones as are opaque to x-ray.

A word on the reduction of unnecessary traumatization of the hilus of the liver, may not be out of place. Dogs subjected to operation on the gall-bladder and ducts seldom die from these ordinary procedures. However, dogs subjected to excessive trauma by dragging, crushing or injection of irritating substances, such as strong salt solution, 90 per cent alcohol or 10 per cent sodium hydroxide, frequently die in shock. The experiment is done by injecting these substances along the cystic and common ducts so that the nerves to the liver are damaged. Clamping and crushing of the vessels surrounding the hilus of the liver will frequently produce shock in a dog. Dragging on the liver and rotating it, as is frequently done in human cases, will produce death in some dogs and will always produce symptoms of shock.

In human cases the excess trauma produces many of the postoperative complications, such as vomiting, etc., and materially increases the mortality and morbidity. In this connection, we may note that thickening of the common duct is not a reason for opening it, since all major bile ducts and the gall-bladder itself are usually altered in cases of cholecystitis. There is also evidence of inflammatory processes invading the hilus of the liver extending along the ducts, and hepatitis of variable degree is invariably present.

Until further evidence is presented, dysfunction of the gall-bladder, stones, strictures or pancreatitis, and the clinical symptoms indicating disease of the liver and gall-bladder will, to a great extent, remain in the realm of surgery. By this statement we do not imply that medical

treatment does not enter into the situation. Close coöperation between internist and surgeon is of paramount importance to the patient, and it is our practice to coöperate with the internist in all cases possible. Many patients operated on for gall-bladder disease require careful and intelligent treatment by the internist after operation. For example, where the pancreas is involved sufficiently to be detectable by palpation at operation, the patient improves slowly and in some cases does not reach the maximum of improvement in less than two years. Medical and surgical research into this almost virgin field should proceed hand in hand; coöperative effort may help the vast number of people suffering from the many symptoms resulting from liver pathology.

Concentration on the pathology involving the liver, pancreas and their ducts should not blind us to the possible contributing causes of these pathologic and frequently fatal conditions. The focal infection hypothesis should be earnestly and conscientiously considered, although it is often erroneous. Frequently we see patients with advanced hepatic disease consulting one specialist after another until all of the possible minor areas of infection have been removed. Operations on teeth, tonsils, and appendix, and all varieties of sinus operations, etc., are usually done first. In the case of female patients the gynecologist does various repairs, removals, etc. A long series of quacks has a chance, and then finally, the internist and surgeon have an opportunity to examine the patient. Most of the *causes* of the liver pathology have probably been removed, but either they were removed too late, or the "wrong cause" was removed.

We believe that patients with longstanding abdominal symptoms, whether esophageal or rectal, should be studied by a competent diagnostician or a group of coöperating specialists, and in all cases of adults with such symptoms a thorough examination should be made. It is our routine practice to do gall-bladder visualization tests, as first advocated by Graham,

in all examinations of adults where gastric symptoms are present.

We believe that in all cases where gall-bladder disease can be demonstrated, the gall-bladder should be removed, cystic duct drainage instituted and the ducts washed out.

#### CONCLUSIONS

1. Subserous cholecystectomy, in our opinion, is the operation of choice in chronic cholecystitis with or without stones.

2. Removal of the cystic duct is not necessary and adds to the hazard of the operation.

3. Cystic duct drainage will lower the mortality.

4. Subserous cholecystectomy with cystic duct drainage will reduce to a minimum operative accidents due to anomalies of the ducts and blood vessels.

5. This procedure also reduces to a minimum the danger of postoperative hemorrhage and bile peritonitis.

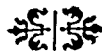
6. Cholangiography may be carried out routinely at the operating table without any appreciable loss of time, thereby

eliminating the possibility of leaving undiagnosed stones or other obstruction in the common duct.

7. This procedure will obviate the necessity of exploring the common duct in many instances, thereby reducing the attendant hazards.

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# FOREIGN BODIES IN THE BLADDER

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THE vast majority of foreign bodies reach the bladder through the urethra, and therefore the size and shape of these objects are largely dictated by the caliber and curve of the urethra. In the female a short, comparatively straight tube allows these bodies to pass fairly readily to the bladder. In the male, however, a foreign body to reach the bladder must be able to adapt itself to the urethral curve, or come to rest in the bulbous portion. The floor of the urethra is quite elastic, and so inserted objects which hug the floor may so furrow it that they too come to rest in the bulb. Pathologic processes, such as urethral stricture and prostatic hypertrophy, may also cause arrest of the foreign body before it reaches the bladder.

Foreign bodies may be removed from the urethra by manipulation, by instrumentation through the urethroscope, or, if infection has made its appearance, by external urethrotomy in the perineal portion.

Foreign bodies may be introduced into the urethra for sexual stimulation either by the patient or his partner, with the blunt end introduced first. In some instances (Fig. 1) the patient may have tied a thin cord to the distal end of the object to facilitate removal. As the distal portion is the pointed end, a tug on the cord only serves to imbed the tip in the floor of the urethra.

An object may become lost in the urethra when the patient undertakes to treat himself, as was the case with the old gentleman who erroneously concluded that the cause of his urinary difficulty was just inside the external urinary meatus. He inserted a hair pin for therapeutic purposes, which immediately disappeared from sight. This occurrence is more frequent in women, who in attempted abortions misdirect articles which find their way into the urethra and

thence to the bladder. Finally, the physician may lose an article in the bladder during urethral instrumentation or cystoscopy, through breakage. These instances are usually of minor concern, for the operator is cognizant of the fact and removes the object at once or as soon thereafter as is practicable.

Migration of foreign bodies from adjacent structures to the bladder is not uncommon. Small missiles or a portion of an unremoved projectile may after a period of time wander from adjacent structures and finally come to rest in the bladder. Thus also a bone peg<sup>1</sup> or a pin,<sup>2</sup> inserted for fixation of the head of the femur, may find its way to the bladder. Rupture of a pathologic viscus, such as a dermoid cyst of an ovary, into the bladder has been reported. Gross<sup>3</sup> recorded the occurrence of a tooth, and Keyes<sup>4</sup> the presence of hair in the bladder from such occurrences.

Foreign bodies may also reach the bladder from the intestine. They may be swallowed and become the inciting agent of vesico-intestinal fistula formation, or occur secondarily as a sign of enterovesical fistula, in which case the foreign substance noticed may be undigested food material. In an instance of our own, fruit seeds were thus found. Though this condition is often associated with intestinal diverticulitis, in our series no diverticula were present.

In operations on the bladder and prostate, a foreign body may be left behind. This may consist of a portion of enucleated tissue or an article from the operator's armamentarium. With the present aid of trained staffs such accidents are indeed rare.

Even suture material may serve as a foreign body in the bladder. This can be obviated by catching all layers of the bladder except the mucous membrane in

closure. Many operators dispense with this precaution, for the use of absorbable sutures has made it largely unnecessary. We have seen, however, two instances in which the patient complained of urinary symptoms, with beginning calcareous incrustation around absorbable suture material. Both instances were cases in which the bladder had been "caught" during an extravesical operation. The material appeared to be chromic catgut. In another instance a surgeon unintentionally opened the bladder during a herniotomy. In closing the bladder the surgeon used linen sutures and included the mucous membrane in the closure. Stone formation resulted on each of the five sutures. (Fig. 4.)

As a general rule, infection and incrustation take place early. The salts deposited are usually phosphatic. The deposition takes place more rapidly on rough surfaces than on smooth ones, usually beginning near the center surface of the foreign body as this is the part more nearly at rest.

Wax also becomes incrustated. Young<sup>5</sup> reported as the first case of floating bladder calculus, an instance in which a coil of paraffin wax had become incrustated with urinary salts. In a case of our own (Fig. 5) some salt deposition was present on the foreign body, a variety of beeswax, in less than three weeks.

A foreign body tends to lie in the transverse axis of the bladder, due to the fact that the transverse diameter of the fixed bladder base is the greater. Should a well defined retrotrigonal bas fond be present, the foreign object will assume the transverse position in this depression. This fact severely limits the possibility of the object being passed without interference.

In the female, rigid foreign bodies of unusual length may be caught in a fold of the bladder wall immediately after introduction, and will therefore lie in a variation of the plane of introduction, or the antero-posterior diameter of the bladder. In the male, such articles would not negotiate the urethral curve, and so would not pass the bulb.

Objects of low specific gravity assume the transverse position only when the bladder is empty, for articles of gum or wax



FIG. 1. X-ray of nail in the bulbous urethra. A black thread, which had been tied to the distal end of the object to facilitate removal, protruded from the urethra. Pressure on the perineum caused a few drops of foul smelling bloody pus to exude from the external meatus. External urethrotomy was done. This showed several centimeters of the urethral floor to be necrotic due to associated infection. (Bellevue Hospital.)

float and thus rise to the uppermost portion of the bladder.

A foreign body may cause slight or no symptoms for some time, or, on the other hand, the symptoms of marked bladder irritation may be present almost immediately after introduction. The larger articles may cause a cessation of the urinary stream. With the advent of infection, which is usually introduced with the foreign body, symptoms of cystitis supervene. If the patient does not seek the advice of a physician through fear, sooner or later the distressing frequency and dysuria causes him to seek relief. These patients may also complain of some suprapubic and perineal pain which limits their activity. Hematuria is usually due to the accompanying cystitis, but in some instances it may be caused by the trauma of the foreign body.

Before any operative procedure is attempted, a careful history should be taken and the patient subjected to a physical

examination. For quite obvious reasons, examination of the perineum in the male should not be omitted. Rectal examination

out before any serious attempt is made to remove the foreign body.

Treatment consists in removal of the



FIG. 2. Flat x-ray plate of an incrustated glass tube lying transversely in the bladder of a young adult male. The tube was inserted per urethra. It was removed by the suprapubic route. (Bellevue Hospital.)

and bimanual examination should be done as a routine. Examination of the rectum and vagina should not be neglected, especially in children.

A flat plate of the abdomen should be taken routinely. It not only serves to substantiate the patient's history but often obviates cystoscopy. This is well illustrated in Figure 2, where cystoscopic instrumentation of the incrustated glass tube would be dangerous, and in Figure 3 where the size of the stone and the danger of bladder perforation by transurethral manipulation make suprapubic cystotomy imperative.

As renal damage may occur through back pressure, associated infection, or coexisting pathology, renal function tests and blood chemical determinations should be carried

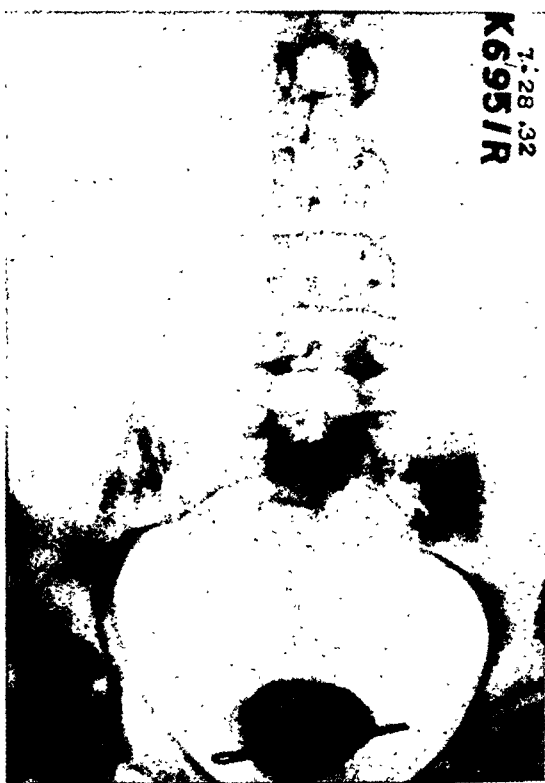


FIG. 3. Stone formation on a bobbie pin lying transversely in the bladder of a young girl. The incrustation evidently began near the center surface. The mass was palpable through the lower abdomen. It was removed by the suprapubic route. (Bellevue Hospital.)

foreign body. The method of removal is dictated by the physical properties of the foreign body and the path by which the article reached the bladder. Small objects introduced per urethra may be removed cystoscopically with the aid of a cystoscopic forceps. Larger foreign bodies are often best removed by the use of one of several cystoscopic rongeurs designed for such purpose. Trauma to the urethra and bladder must be avoided in these manipulations.

Some articles present special difficulties. Thus Kimbrough<sup>6</sup> was unable to turn a hair pin in the bladder of a 4 year old girl, without running the risk of severe traumatization. By the use of an improvised snare

he was able to loop the free ends of the pin and draw these tightly to the scope. Articles of glass may be small enough to be

the urethra where it had become impacted. In this instance, the boy fell astride a picket fence and the splinter was driven up



FIG. 4. Stone formation on five non-absorbable linen sutures used in bladder closure. Incrustation removed from one suture. Removal by instrumentation was impossible because of position and danger of bladder perforation. Sutures were removed by suprapubic cystotomy. (Scale in centimeters.)

easily removed through the cystoscope. Should there be any danger of shattering the glass object, then, even though small, it had best be removed suprapubically.

Pliable cord-like articles introduced into the bladder per urethra may be removed cystoscopically. If the article inserted is of some length it may have become so entwisted or knotted that removal through the urethra is impossible. Removal by cystotomy is then the only recourse.

With few exceptions foreign bodies which have migrated from adjacent structures to the bladder are best removed suprapubically. However, if the object is small and has not given rise to permanent sinus or fistula formation it may be removed per urethra by cystoscopic instrumentation. Crane and Moody<sup>7</sup> using an F. 18 panendoscope, removed a splinter of wood from the bladder of a 7½ year old boy one month after accident. A smaller piece had previously been removed from

the inner aspect of the thigh through the obturator foramen into the bladder.

Bone pegs and pins, used for fixation of the head of the femur, which have migrated to the bladder are best removed by suprapubic cystotomy. The curettement or excision of a sinus tract may be essential, and after closure of the bladder defect, extravescical drainage to facilitate healing is often necessary.

Where the foreign body is due to associated pathology of an adjoining organ, such as a dermoid cyst of an ovary, surgical removal of the pathologic process is indicated. After closure of the bladder sinus suprapubic drainage by means of a Pezzer catheter is safer than catheter drainage per urethra.

The diagnosis of vesico-intestinal fistula is not difficult. The symptoms of cystitis, such as frequency and dysuria with pyuria, pneumaturia, and the passage of fecal matter and undigested food particles, is



quite conclusive. Whether the fistula is the result of the foreign body or the foreign particles the result of the fistula is not so

scopic and proctoscopic examination may be indicated.

As a rule, during operation for closure of



FIG. 5. Beeswax removed from the bladder of a 16 year old boy. As beeswax is brittle, several sharp blows with a closed snare, improvised from a double strand of piano wire and a ureteral catheter, sufficed to break the foreign body into several pieces, which the patient passed on voiding. Two portions not shown were lost down the drain. (Scale in centimeters.)

important. The primary concern is the eradication of the fistulous tract. The presence of malignancy or of a specific inflammatory process should be ruled out. Before operation an effort should be made to determine the exact level of the portion of the bowel involved. This point may definitely influence the operative procedure. For instance a colostomy would be of no value if the fistula involved the small bowel.

Cystoscopy will locate the exact position of the fistulous opening in the bladder. Catheterization of the vesical stoma of the fistula and injection of an opaque solution may be helpful or cystograms may be made with an attempt at backflow of the opaque solution into the intestine. Severe reaction following the use of sodium iodide in the latter procedure has, however, been reported.<sup>8</sup> Fluoroscopy and x-ray of the intestinal tract after the administration of barium by mouth or enema as indicated is most important. In fistulae involving the distal portion of the large bowel, sigmoido-

an enterovesical fistula, the intestine is first disposed of, for should it become necessary to terminate the operation at any time, it can be done thereafter with a minimum amount of risk to the patient. The operative procedure may involve only the removal of the appendix, simple closure of the intestinal opening or a bowel resection. In the case reported by Herbst and Miller,<sup>9</sup> where the fistula was caused by a bone from the intestinal tract, three separate operations with several weeks interim were necessary. The first stage consisted of freeing the appendix from the cecum, and resecting a portion of the involved sigmoid. This mass was left adherent to the bladder. A colostomy was done to sidetrack the fecal stream. The second operation involved the removal of the resected mass from the bladder and closure of the vesical defect. The third stage consisted of a lateral anastomosis to establish continuity of the large bowel.

In our own case of fistula involving the bladder and sigmoid portion of the large

bowel, the fistula recurred after the first operation. Bladder drainage had been accomplished through an in-dwelling cathe-

coils usually maintain their identity and a composite mass does not form until later, especially in the case of the firmer waxes.



FIG. 6. Ureteral catheter passed into the sigmoid colon from the bladder, through intestinovescical fistula. Note the relationship of the colostomy performed to divert the fecal stream and relieve tension prior to operation for closure of the fistula. The opaque solution injected to outline the tract has run back into the bladder.

ter. Prior to the second operation a colostomy was done. After closure of the fistula had been effected the bladder was drained suprapubically through a large Pezzer catheter. Recovery was uneventful. The patient has been well for over two years.

Because of their physical properties, foreign bodies of gum or wax should be considered separately. Paraffin wax may produce a cystitis within twenty-four hours. Though wax and gum objects are usually introduced in pencil form, they tend to curl up due to body warmth and the contractile force of the bladder. This makes passage on voiding impossible. If the wax pencil introduced is comparatively thick, or the object is a wick-containing candle then the curling up process is delayed. Such bodies, like rigid objects, will come to rest in the transverse diameter of the bladder base as the bladder empties. The slender wax pencils curl up quite readily. In the beginning of this process the

The importance of this observation is shown in the example of a lad of 16, who for the purpose of sexual excitement, introduced into his urethra an improvised pencil of a variety of beeswax (Fig. 5) and promptly lost it. The ensuing cystitis caused him to seek relief. While trying to remove the irregularly coiled wax body from the bladder by means of a snare, we noted that an elbow of the coiled wax broke off when struck with the closed snare. As this particular type of wax is quite brittle, several sharp blows broke the object into a number of small pieces, after which the cystoscope was withdrawn. The patient voided the particles before leaving the office.

In another instance, because of the buoyancy of the wax object in a water medium and poor visibility in that portion of the bladder directly above the bladder neck, the bladder was filled with mineral oil and the piece of wax removed from the

floor by means of a Young's rongeur. One should guard against overdilatation of the bladder in this procedure. O'Neil<sup>10</sup> described this method in 1931, using an olive oil medium, but recommended the use of mineral oil as olive oil becomes rancid. In the female the use of the open air cystoscope makes this procedure unnecessary.

Gum rapidly forms a composite mass in the bladder. In two cases we have removed portions of gum from the bladder by means of a Young's rongeur, but in both a portion of the gum remained in the bladder. In each instance the remaining gum was passed by the patient shortly after instrumentation. Gum, like wax, also sinks in mineral oil.

Although we have never used solvents to remove gum or wax from the bladder, there are instances where the solvent method is superior to any other. However, if encrustation has taken place on the foreign body, the action of a solvent is nullified and recourse must be had to some other procedure.

The removal of gum or wax from the bladder by means of solvents may be accomplished by any one of three methods. The undiluted solvent may be used, being injected into the bladder through a catheter. Lyons<sup>11</sup> reported an instance where the patient was allowed to void the bladder contents after benzene had been injected for the removal of chewing gum. This resulted in a severe urethritis, with some blistering and infection of the scrotum and thighs where the fluid had dribbled.

Harris<sup>12</sup> and later Katzen<sup>13</sup> injected warm mineral oil into the bladder to rid the patient of a wax candle. The patient retained the oil several hours. Additional measures such as gentle massage over the bladder region and heat by means of hot water bottles and hot sitz baths were used.

Caples<sup>14</sup> and later Melin<sup>15</sup> removed a wax pencil from the bladder by using a mixture of one third low grade gasoline (55° Baume scale) and paraffin oil; 125 c.c. of this mixture was injected after it had been heated to 110° F. This was retained

for several hours by the patient. A number of daily treatments were necessary.

In the method used by Hattinger<sup>16</sup> the bladder is filled with boric acid solution or sterile water and then 12 c.c. of xylol is run in through the catheter. As the xylol floats on the surface of the water, much of the bladder mucosa is unexposed to its effect. By having the patient change his position from time to time, exposure of any one portion of the bladder to the concentrated solvent over a lengthy period is avoided. In Hattinger's case the patient passed a milky solution containing the dissolved foreign body after two hours. Cystoscopy thereafter was negative. This procedure was later used by Turner<sup>17</sup> with equal success, the solvent in this instance being withdrawn through a catheter.

Prior to instrumentation or the use of solvents it may be advisable to irrigate the bladder for several days to alleviate the distress due to the accompanying cystitis. All solvents used should be run into the bladder through a catheter. After the allotted time has elapsed the bladder should be emptied by means of a catheter and the bladder irrigated to wash out any remaining solvent.

The use of solvents, such as xylol, carbon tetrachloride, gasoline or kerosene, in large quantity should be avoided. Their use is not without some danger. Ether<sup>18</sup> because of its escharotic action should never be used. Mineral oil can be used in quantity and safely applied over a long period of time. Though its action is comparatively slow (Fig. 7), the fact that the wax body need be partially only dissolved in order to be passed makes mineral oil an ideal solvent. However as a solvent for the firmer waxes such as beeswax, and for chewing gums, mineral oil is comparatively useless. (Table 1.) Gum or beeswax may be removed by instrumentation as previously described, or a solvent such as xylol or benzene may be employed according to the method of Hattinger. It is interesting to note that gum is usually chewed before it is inserted into the urethra. This factor

makes cystitis almost a certainty but aids the action of the solvent, for gum exposed to a solvent without first having been chewed or placed in a watery solution, dissolves very slowly.

When the foreign body has been removed, whether by instrumentation or solution, the bladder should be examined several days later to ascertain that no foreign particles remain. In some instances,

cystoscopic instrumentation is impossible, or if the article is of a variety which makes instrumentation hazardous, removal by suprapubic cystotomy is indicated. The obliteration of the channel formed by the object in its migration to the bladder may necessitate additional surgery.

Foreign bodies of gum or wax may be removed cystoscopically. Waxes with comparatively high melting points, such as

TABLE I  
COMPARATIVE SOLUBILITY

Commercial Wax	12 C.c. Xylol	12 C.c. Benzene	12 C.c. Carbon Tetra- chloride	12 C.c. Gasoline	12 C.c. Kerosine	25 C.c. Mineral Oil	25 C.c. $\frac{1}{3}$ Gasoline $\frac{2}{3}$ Mineral Oil
Paraffin	55 min.	1 hour.	55 min.	1 hour 10 min.	3 hours.	9 hours.	2 hours.
Crayon	55 min.	1 hour.	55 min.	1 hour.	2 $\frac{3}{4}$ hours.	10 hours.	2 $\frac{1}{2}$ hours.
Candle	45 min.	1 hour.	1 hour 10 min.	1 hour 20 min.	2 $\frac{1}{4}$ hours.	8 $\frac{1}{2}$ hours.	2 $\frac{1}{2}$ hours.
Beeswax	4 hours.	5 hours.	4 hours.	8 hours.	32 hours.	Slight action in 72 hours.	Some action in 72 hours.
Chewed chewing gum	30 min.	30 min.	30 min.	30 min.	2 hours.	Slight action in 72 hours.	Slight action in 48 hours.

Articles used are those which have been reported as vesical foreign bodies. Specimens were 1 inch long by  $\frac{1}{4}$  inch in diameter. One inch of common chewing gum stick was chewed for fifteen minutes. The temperature was kept at 37.5°C. and the specimens were shaken every fifteen minutes for ten hours. Note the relative insolubility of beeswax and chewing gum in mineral oil and one-third gasoline and two-thirds mineral oil. Note also the slow action of kerosene on beeswax.

as with a candle, the insoluble material, in this instance the wick, may require removal through a cystoscope.

#### SUMMARY

Most foreign bodies reach the bladder per urethra. They may also migrate from adjacent structures or from the intestine, in which case the presence of an entero-vesical fistula may further complicate the picture.

The mode of removal of foreign articles is largely dictated by their physical properties and the path by which they reached the bladder. In many instances, removal of these foreign bodies may be safely accomplished by cystoscopic instrumentation. If

beeswax, are brittle and can be broken up into smaller particles through the cystoscope, after which they will be passed with little difficulty. Wax and gum may also be disposed of through the proper use of solvents. The use of concentrated solvents in large quantity should be avoided. Mineral oil is an exception to this rule. If concentrated solvents are used they should be employed in small quantities and in such a manner that the bladder trigone is not exposed.

I wish to thank my former chief and teacher, Dr. A. R. Stevens, Director of the Department of Urology, Bellevue Hospital, New York City, for his permission to use Figures 1, 2, and 3 in this article.

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VAGINAL polyps are occasionally found in children. Their discovery usually follows upon the investigation of vaginal bleeding.  
From—"Pediatric Surgery" by Edward C. Brenner (Lea & Febiger).

# THE GYNECOLOGIC PATIENT WITH URINARY SYMPTOMS\*

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THIS analysis of 200 consecutive female patients with urinary symptoms is from the cystoscopy clinic of the Gynecologic Division of the Mt. Sinai Hospital, New York City.

Where gross urologic conditions such as tuberculosis, neoplasms, calculi, etc., were found in the course of our gynecologic urologic investigations, the patients were transferred to the urologic service. Such lesions as urethritis, submucous infiltrations, inflamed glands, stricture and neoplasms of the urethra were ruled out by routine endoscopy, or when found received appropriate treatment. These are not included in the cases reported here.

After excluding the above cases, there are left a host of minor lesions and bladder disturbances, which, however, play a very major rôle in the discomfort and unhappiness complained of by gynecologic patients. They challenge all of our resources in their treatment. It is only by the most meticulous accuracy in localization, the utmost gentleness and niceness in manipulative procedures, the utilization of a variety of physical, hydrotherapeutic, chemical and psychotherapeutic measures, and the exercise of extraordinary patience that we are able to obtain adequate results. A special cystoscopic clinic therefore is of inestimable value, and constitutes an essential part of a gynecologic out-patient department.

This analysis is discussed under the following headings: age, marital status, obstetrical and surgical trauma, menopause, symptomatology, pathology and treatment. The purpose of this study was to help clarify the correlation of symptoms

to definite bladder disease, the applicability of specific treatment for specific pathologic conditions and to standardize our treatments based on cystoscopic findings.

*Age.* The average age in this series is 44.5 years; 70, or 35 per cent, were in the menopause, and of the latter, over a third complained of typical menopausal symptoms. At the menopause, among the recognized factors in the genesis of urinary symptoms are the local atrophy, the increased sensitivity to moistening by urine, and the lowered threshold of the vasomotor and sympathetic systems. Urinary symptoms in this group, part of the larger picture of the menopause, react well to general sedation and, in selected cases, to hormonal therapy.

*Marital Status.* The greater proportion, 97 per cent, were married or had been married. The effect of marital maladjustment as related to various bladder symptoms, and particularly the rôle of coitus interruptus, properly belong to the field of scyphotherapy. The cases belonging to this group have been separately studied by Dr. Max Mayer in his special clinic, and will not be included in this report. It is well recognized that psychogenic factors may play a considerable part in urinary symptomatology. In this series, an amazing number (50, or 25 per cent) were found to have had some form of neurosis. This number includes those with menopausal symptoms accompanied by mental disturbances of varying degree. Many of the patients who complained considerably of urinary symptoms, were found to have a normal bladder or a mild trigonitis, and

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were not relieved by local treatment unless accompanied by some form of psychotherapy.

**Gravidity.** Seventy-nine, or 90 per cent, of the patients were parous. Gravidity is of importance in the production of bladder symptoms because of the not infrequent cystoceles, urethroceles, prolapses, etc., as well as the low grade infections of lacerated cervixes. The latter should not be neglected in the treatment of recurrent bladder infections. At this point we may call attention to the importance of treating vaginitis, especially trichomonas vaginalis vaginitis, with or without parasitic invasion of the urethra. Seventy-five, or 38 per cent, showed evidences of obstetrical trauma; 53 per cent had cystoceles, 12 per cent urethroceles and 22 per cent lacerated cervixes of the remainder, many showed cystorectoceles, prolapses, etc.

**Surgical Trauma.** Ninety or 45 per cent of the patients had had some operative procedure. Of these, 27 per cent had had plastic repairs of birth injuries and 30 per cent other gynecologic operations. It seems probable that the mobilization of the bladder from above or below occasionally interferes with its innervation or vascular supply and predisposes to local symptoms. Ordinarily, the postoperative cystoscopic examinations following anterior colporrhaphy show a surprising degree of restitution to normal. In some instances there is seen, for a time, a median ridge formation with increased vascularization of the mucosa and a tendency to bleeding on the slightest manipulation. Rarely, a penetrating stitch causes a temporary superficial ulceration or localized bullous edema. Excessive plication may cause temporary dysuria and even retention, but these symptoms respond with great rapidity to the simplest measures, such as periodic emptying of the bladder and occasional bland irrigations. Occasionally a distinct bar formation is seen instead of a median ridge. This group seems to respond readily to the passage of a sound. The ureters were never found compromised as a result of

anterior wall plastic repair or parametrial fixation operations.

**Anatomy and Pathology.** Since this special clinic also served the function of instruction in cystoscopy and gynecologic urology to the younger members of the staff, we have emphasized the importance of a systematic search for any urologic lesions. In the instruction, the importance of diagnosing the exact site of the inflammation, congestion, or edema has been emphasized, for such a differentiation is vital in the choice of therapy. For purposes of cystoscopic orientation, the urinary tract was divided into the following divisions with the common lesions to be sought under each of the headings:

- I. Urethra:
  - (1) Caruncle
  - (2) Urethrocele
  - (3) Relative stricture
  - (4) Urethritis
- II. Internal sphincter:
  - (1) Excursion disturbances
  - (2) Edema
    - (a) Villus formation or papillomatous excrescences
  - (3) Bar formation
  - (4) Congestion
- III. Bladder neck or vesico-urethral junction:
  - (1) Edema (bullous and cystitis cystica)
  - (2) Congestion
  - (3) Exudate
- IV. Trigone:
  - (1) Edema
  - (2) Congestion or hyperemia
  - (3) Exudate
  - (4) Distortion
    - (a) Pressure by fibroid, etc.
- V. Fundus and rest of bladder:
  - (1) Distortion
  - (2) Diverticulum
  - (3) Ulcer
- VI. Ureteral orifices:
  - (1) Appearance (edema or exudate)
  - (2) Location
  - (3) Number (accessory)

## VII. Ureters and kidneys:

- (1) Stricture
- (2) Dilatation
- (3) Calculus, etc.

The internal sphincter is treated here as a special entity, separate from the bladder neck with which it usually has been included. Normally when the cystoscope is turned laterally, the sphincter resembles a crescent or quarter moon, and its lower or posterior portion does not project above the surface and is not sharply differentiated, but seems continuous with the posterior urethra and floor of the bladder. However, where edematous, it may loom up in a bar formation as a barrier beyond which it is difficult to see the bladder neck. Sometimes the entire trigone or the margin may become irregular, with a scalloped appearance or lined with polypoid excrescences.

The area between the internal sphincter and the trigone may be called bladder neck or vesico-urethral junction. This is often the site of a simple or a bullous edema. Carcinoma of the cervix or uterus and pyosalpinx, which may be the source of a bullous edema, must be ruled out. An exudate may cover this area and extend over the trigone. Here the pathology may vary from a simple hyperemia, which is most common, to a marked edema with obliteration of the blood vessels. Narrowing of the urethra or relative stricture should always be looked for, as it is often the source of severe bladder symptoms, even though an ordinary metal catheter may be passed easily.

Lesions of the upper urinary tract are excluded by ureteral catheterization and intravenous and retrograde pyelography. When pathologic conditions are found, they are referred to the surgical division for treatment. The conditions found are listed in Table 1 (description involves considerable overlapping).

One hundred and forty-nine patients, or 75 per cent, had lesions at or near the bladder neck. Including bar formation and relative stricture, fifty-four, or 27 per cent, had edema of the internal sphincter. It is

TABLE 1

	No. of Cases	Per Cent
Edema of bladder neck.....	77	38.5
Edema of internal sphincter.....	30	15
Bar formation.....	24	12
Congestion of the trigone.....	38	19
Edema of the trigone.....	35	16.5
Edema of bladder neck and trigone.....	22	11
Relative stricture of urethra.....	18	9
Urethral caruncle.....	11	5.5

obvious, therefore, that the term cystitis usually applied to so many female patients with urinary symptoms is too broad. A generalized cystitis was rarely seen, as the bladder above and lateral to the trigone is usually normal.

At this point it may be well to consider the importance of the examination of the urine. A catheterized specimen is obtained from each patient when first seen. If the specimens contain frank pus or blood, ureteral catheterization is done as soon as feasible. With the exception of some instances of acute cystitis or upper urinary involvement, most of our cases showed a practically normal urine. A routine urine examination therefore cannot be relied upon as an index of a pathologic condition in the genitourinary tract, particularly in the bladder.

*Symptomatology.* The cardinal symptoms were in their order of importance, frequency, burning, incontinence, and urgency, occurring alone or in combination. One hundred and eight, or 54 per cent of the cases, complained of frequency of urination. Of these, twenty-nine did not return for treatment after cystoscopy. Of the remaining eighty-one, forty-six, or over 50 per cent, were cured or much improved and thirty-two somewhat improved.

Eighty-two, or 41 per cent, complained of burning urination. Urgency was recorded in only nineteen cases, but I believe it to have been more frequent than these figures indicated. Some of our standard terms, in a history, offer considerable difficulty in



their translation for foreign patients. It is also difficult to evaluate treatments for specific urinary symptoms, as they usually do not occur singly.

Incontinence was found in forty-five, or about 22 per cent of the cases. Edema of the sphincter and bar formation were more prominent in patients with this symptom. However, many of these cases also had frequency, burning and urgency. Of the forty-five, six were not cystoscoped and five were not treated, leaving thirty-four, of whom seven were cured, twelve much improved, ten somewhat improved and five not improved. An important part of the examination of each case of incontinence was a complete neurologic investigation to eliminate any possible lesion of the central nervous system.

Other symptoms, such as hematuria, pyuria, backache, pain in the loin and flanks, were investigated and treated in the usual manner. Nephroptosis is an occasional etiologic factor in symptom production.

We have assiduously avoided a blanket diagnosis of "cystitis," which in the past, has resulted in the routine irrigation and instillation therapy. Instead, by careful topographic differentiation, we feel that we obtain results that are quicker and more lasting.

*Treatment.* The treatment may be divided into general and local. In the former are measures used when the symptoms form part of a constitutional condition, such as neurosis, menopause, cardiac condition, etc. Local procedures consist of hot douches and hot sitz baths, bladder irrigations and instillations, bladder distentions, Kelly treatments, dilatations of the urethra with massage, or a combination of any of the above. Hot douches and sitz baths were used alone or with sedatives in cases of mild congestion of the trigone, bladder neck or of the rest of the mucosa. Symptoms very often improve without further treatment, particularly where associated with an inflammatory condition in the pelvis, such as salpingitis or para-

metritis. Of the thirty-eight cases of congestion of the trigone, thirty-two received this treatment alone or continued with irrigations. All patients were instructed to take prolonged hot douches and sitz baths daily in conjunction with any of the other treatments for the general effect produced by heat and hydrotherapy. When indicated, diathermy was used freely as a physiotherapeutic adjuvant.

Bladder irrigations with or without instillation of argyrol, silver nitrate, etc., were the treatments given for a more severe trigonitis, cystitis or considerable injection of the bladder neck.

Hydraulic distention of the bladder is used in a limited number of cases where the capacity of the bladder is diminished, due either to chronic cystitis or to extravesical pressure. These cases have frequency as a major symptom, and when they are enabled to hold at least 300 c.c., their symptoms are greatly improved.

Heretofore in this clinic, most of the cases of edema of the sphincter, vesico-urethral junction and trigone were routinely given topical application of 5 per cent silver nitrate over this area, as described by Kelly. In an analysis, it was found that a great many returned to the clinic repeatedly with little or no improvement. This treatment, often in conjunction with dilatation, was used for edema of the bladder neck, especially bullous edema and severe edema of the trigone, particularly where an exudate covered this area. However, as it was found that many of these cases were completely relieved by dilatation of the urethra, this is being used more frequently at present.

Dilatation, or the introduction of Hegar dilators or sounds past the internal sphincter, accompanied by massage of the urethra on the sound by the vaginal finger is a form of treatment used frequently in this clinic. The technique and results of this treatment, particularly for incontinence and enuresis had been noted as far back as 1888, when Oberlander described incontinence as an irritation of the reflex caused by the

urethral muscles in the region of the sphincter, and recommended urethral dilatations. Since then, Sanger and Credé in 1890, Bagot in 1891, and others up to Hinman in 1935, have reported success with this method. It was a theory of most of these writers that incontinence was caused by a weakness of the internal sphincter. The beneficial effect of the procedure depended on the fact that the sphincter, through the irritation of the stretching, would reflexly contract more strongly, increase muscle tone and set up a certain degree of work hypertrophy.

Treatments are given weekly, gradually increasing the caliber of the dilators, until a No. 10 or 11 Hegar or a 28 French sound is reached. Usually, not more than six to nine treatments are given, and often the symptoms subside following one treatment. This may throw light on the occasional cessation of symptoms following a simple cystoscopy. This treatment was found to be almost specific for edema of the internal sphincter or bar formation and relative stricture of the urethra. In the latter cases, although the urethra admitted a catheter easily, results were not obtained until it was possible to introduce painlessly a sound of a larger size. Table II shows the results obtained in those cases treated by dilatation.

TABLE II

	No. Dilated	Cured or Greatly Improved	Improved	Not Improved	No Check-Up
Edema of the bladder neck.....	44	30	7	1	6
Edema of sphincter.....	27	18	3	2	4
Bar formation.....	20	10	4	2	3
Relative stricture of urethra.....	18	12	4	2	0

Other methods of treatments were successful, but none so rapidly or permanently as the dilatation. We have, of course, not ignored the probability of a strong suggestive element in the treatment. Results of this treatment in the cases of incontinence were excellent when there was an

edema of the sphincter and bladder neck. (Table III.)

TABLE III

	No. Dilated	Cured or Greatly Improved	Improved	Not Improved	No Check-Up
Incontinence.....	23	14	5	2	2
Frequency.....	37	25	7	2	3
Burning.....	37	23	10	3	1
Urgency.....	11	8	2	1	1

The eleven cases of urethral caruncle were cauterized. Eight were cured and three were only slightly improved, the latter having been found to have bladder disease.

## SUMMARY

1. Our experiences with 200 consecutive minor urologic cases in gynecologic patients is here reported.
2. A special cystoscopic clinic is an essential part of a gynecologic out-patient department.
3. Topographic subdivision of the bladder is of value in practical diagnosis.
4. Treatment should not be routine, but should be specific for each type of bladder disease.
5. There are various constitutional and mental factors that are important in the selection of proper treatment.
6. In this series, over 90 per cent of the patients presented pathologic conditions about the bladder neck and internal sphincter.
7. Dilatation of the urethra is found to be of great value in this type of patient.

I wish to express my thanks to Dr. J. J. Squire for his help in the preparation of the tables, and to Dr. Max Mayer for his advice in the elaboration of this paper.

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ALTHOUGH no part of the body is immune [in children], certain regions are especially subject to the development of new growths. The kidneys and adrenals are most frequently involved and furnish approximately 30 per cent of the malignancies of childhood. The bones, brain and meninges, and the eye and orbit are next most common sites and each accounts for approximately 10 per cent.

From—"Pediatric Surgery" by Edward C. Brenner (Lea & Febiger).

# NON-SPECIFIC SALPINGITIS

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THE experiences of gynecologists during the last two decades have brought out increasing evidence that there is no clinical and pathologic picture which is absolutely typical for a gonorrheal infection of the female pelvic organs in general and the Fallopian tubes in particular. Various other infective agents have been found capable of producing pictures resembling textbook descriptions thought to be characteristic of specific infection of the female pelvic organs.

## GENERAL PATHOLOGY OF SALPINGITIS

The manner in which an infection enters the Fallopian tubes varies with the type and the virulence of the infecting organism. It may spread from the cervix through the uterine cavity, entering the tube through its uterine opening; it may enter from the peritoneal cavity through the ampulla, or it may be carried by the lymphatics or the blood stream either from neighboring organs or from some distant focus. When the infection enters through the uterus, both tubes are usually affected simultaneously.

In the acute type of inflammation, the tube is swollen, its tortuosity increased, the mucous membrane congested, and the fimbria reddened and swollen. There is a hypersecretion of mucus. Microscopically, the epithelium of the mucous membrane is swollen and has lost its cilia. The submucosa is infiltrated with leucocytes and round cells.

Depending upon the origin and type of infection, either the inflammatory process starts at the endosalpinx and spreads through the muscles to the peritoneal covering; or, if the infection has been carried through the lymph or blood vessels, the initial lesion is in the wall of the tube, spreading from there.

Unquestionably a large number of cases of salpingitis are abortive and do not go beyond the initial stage characterized by swelling, congestion, and mucous secretion of the tube. Even in this stage the adjoining structures and the ovary are usually found to participate in the congestion and edema, and some serous exudation shows an associated peritoneal irritation.

If the process does not advance beyond this stage of catarrhal salpingitis, complete resolution and restitution to the normal condition is usual. But when the inflammation progresses, the secretion of the tube becomes purulent, and inflammatory adhesions form, involving the fimbria, the inner folds of the mucosa, and the adjoining structures and ovary in varying degrees. Partial or complete obstruction of the tube is the well known sequela. Salpingitis nodosa is the final stage of a localized infiltration within the tubal wall. Hydro-salpinx, pyosalpinx and tubo-ovarian abscesses are common results of repeated attacks.

## ETIOLOGY

As mentioned before, it is often difficult to differentiate between the evident clinical manifestations of non-specific and specific infections. Robert Cruikshank analyzed a recent series of 200 women sent to a venereal clinic as cases of clinical gonorrhea. He found that an exhaustive bacteriologic and serologic study failed to show evidence of gonorrheal infection in 45 per cent.

Statistics on the relative frequency of the various types of infections responsible for salpingitis differ greatly. A notoriously unreliable source of information as to the etiology of salpingitis is the personal history. In a total number of 545 cases of

salpingitis, Farr and Findlay obtained the history of gonorrhea in less than 3 per cent of the cases.

The main difficulty in discovering the etiology of salpingitis arises from the fact that the majority of tubes surgically removed have been found to be sterile.

A summary of statistics covering 753 cases from a number of European clinics, dating from a time when many tubes were surgically removed, showed: approximately 60 per cent sterile; 24 per cent containing gonococci; 11 per cent staphylococci and streptococci; 3 per cent tubercle bacilli; and about 1 per cent each of pneumococci and colon bacteria.

In a clinical, pathologic, and bacteriologic study of nearly 300 salpingitis cases, Curtis also found that the majority of tubes removed at operation were sterile. However, from the total evidence collected, he came to the conclusion that more than 70 per cent of the lesions were most likely produced by a gonorrheal infection. Five per cent were of tubercular origin and more than 15 per cent were entirely due to other pus producing bacteria, notably various types of streptococci.

It is a well known fact that gonococci survive for only a short time in pus tubes; and if not reinfected from the cervical glands, in which the gonococci can live indefinitely, pus tubes become sterile within a few weeks. On account of this experience, the cases of salpingitis found to be sterile were commonly attributed to gonococcus infection. However, numerous other microorganisms of relatively mild virulence have also only a limited viability in the tubes. Only the tubercle bacilli and a few highly virulent strains of streptococci are able to survive for unlimited periods in the pelvic structures.

The histologic pictures of salpingitis are also not specific for any one type of infection. The claims of Schridde that gonococcus infection leaves characteristic pathologic changes within the tubes have been disproved by later investigators. It is commonly accepted that streptococcus

infections ascend through the lymphatics to the parametrium and eventually to the tubes. However, Frankel observed cases in which streptococcus infection had apparently invaded the tube along the mucous membrane from the uterus, producing pathologic changes identical with those commonly ascribed to the gonococcus. With the growing experience that certain non-specific infections can produce pathologic and clinical pictures similar to those due to the gonococcus, it has been necessary to qualify the earlier notion that practically all cases of salpingitis result from gonococcus infection.

The English surgeon, MacKenzie, found that in his hospital near Manchester, less than 40 per cent of salpingitis cases were produced by gonococci, and the pure or mixed cultures of pyogenic cocci were more commonly responsible. Polak claimed that not more than 40 or 50 per cent of tubal infections are produced by gonococcus. In a large number of women on whom he operated for sterility, he found mild chronic tubal inflammations which could not be traced to any gonorrheal infections. In quite a few of these cases other pyogenic cocci could be found in the prostatic secretions of the partner. He thought it likely that non-specific pyogenic bacteria in the prostate of the husband can set up an infective endocervicitis in the wife, harmless in the majority of cases except for a constant, mucopurulent discharge. In such a case, any manipulation involving the cervical canal is apt to produce an endometritis and salpingitis.

There is no reason to doubt that, like gonorrhea, this type of infection can also spread spontaneously during menstruation, due to the accompanying lowered immunologic resistance, the physiologic congestion, and the favorable cultural medium of menstrual blood.

The literature shows numerous case reports of non-gonorrheal and non-puerperal salpingitis occurring even before the menstrual age. Riedel collected five cases of salpingitis of unknown origin causing a

fatal peritonitis in children under 10 years. Mazel reported the removal of a pus tube in a 10 year old child in whom repeated smears and cultures for tubercle bacilli and gonococci were negative. Caussade and others described salpingitis cases due to colon bacillus. There are a few case reports of parametritis and salpingitis following measles and scarlet fever, and quite a few had apparently a causal connection with influenza and the common cold.

Recent observations of Edward Allen and others show that acute pelvic inflammation may be associated with adnexal swellings, temperature and leucocytosis in a number of cases exhibiting trichomonas vaginalis. These attacks usually follow the menstrual period, but repeated smears and complement fixation tests for gonococci were negative. However, Allen and his co-workers isolated from the vaginal secretions associated with trichomonas a strain of streptococci which they believe responsible. The same type of organisms could be isolated from infected Bartholin glands in other trichomonas cases. They are inclined to think that pelvic cellulitis and salpingitis secondary to trichomonas vaginalis infection is a more common occurrence than is generally supposed. And they believe it not unlikely that the associated streptococci may ascend the genital tract of women almost as readily as gonococcus.

#### DIFFERENTIAL DIAGNOSIS

The frequently experienced difficulty in making a differential diagnosis between acute salpingitis and appendicitis is even more pronounced in cases of non-specific salpingitis in which the bacteriologic and serologic tests for gonorrhea are negative, and when no history and no signs of exposure are present.

Of the numerous points which differentiate acute salpingitis from acute appendicitis, I want to emphasize a few of the most significant.

An important characteristic in the history of salpingitis is that the majority of cases start subsequent to or during the

latter part of a menstrual period. The period in question is most often described by the patient as having shown some unusual features as to the time of its arrival, length of duration, amount, or concomitant distress.

In acute appendicitis, a beginning with upper abdominal pain is the rule, in salpingitis the exception.

Of clinical signs, vaginal and rectal examination in acute salpingitis show tenderness of the fornices, usually on both sides and behind the cervix; a certain resistance of the parametrium may be felt, but no adnexal tumor in the initial stages. Attempts to move the cervix are painful.

Temperature, leucocyte and differential counts differ more with the type, virulence, and stage of the infection than with the localization in tube or appendix.

The most reliable guide in the differential diagnosis has recently been proven to be the blood sedimentation time. According to experiences of Lesser and Goldberger in a large series of cases, the sedimentation reaction offers a distinct aid in the differential diagnosis between acute salpingitis and acute appendicitis, salpingitis giving a consistently abnormal blood sedimentation reaction, appendicitis a consistently normal one. Harold Brunn confirms, through experiences of his own, the importance of the blood sedimentation test for the most difficult differential diagnosis between pelvic appendicitis and salpingitis. According to C. T. Smith and others, the increased rate of sedimentation is most significant during the first twenty-four to forty-eight hours after onset of symptoms in acute salpingitis, as compared with relatively normal sedimentation time in acute appendicitis.

But even when all the differential points which distinguish acute salpingitis from acute appendicitis are known and considered, there still remain a few atypical cases in which a differential diagnosis is impossible to make, and a diagnosis of appendicitis either is made or cannot be excluded with safety. Exploration in such

cases is not only justified, but occasionally unavoidable. In a large series of cases with the final diagnosis of salpingitis, Polak and Farr and Findlay found that 10 to 15 per cent had been operated upon with a pre-operative diagnosis of appendicitis.

#### CASE REPORT

I want to report briefly a case of non-specific salpingitis in a girl of 17 years. Menstrual history was negative. She complained of gradually increasing dull pain in the lower right quadrant for approximately two weeks. It had started several days after an apparently completely normal menstruation. The pain was always localized. There was no nausea, vomiting or constipation, and no urinary symptoms. There was no distention; temperature and pulse were normal; urine negative; leucocyte count varied between 8,000 and 13,000, with a relative lymphocytosis. Sedimentation tests were not taken. As the pain became increasingly severe and the evening temperature started to rise, the patient was taken to the hospital for observation.

On the morning of her arrival, temperature was 98, pulse 80, white count 8,600 with 72 per cent polys. The patient felt quite comfortable. During the day pain increased, her temperature rose to 100.8, her pulse to 90, white count to 13,000 with 70 per cent polys; catheterized urine was negative. Clinical examination showed localized tenderness centering in an area about 5 cm. right of the umbilicus. There was slight rigidity and rebound tenderness. Since the patient had a virginal introitus, no vaginal examination was made. A moderate amount of whitish, thin vaginal discharge was observed but not examined at this time.

Rectal examination showed a normal sized uterus in anteversion; the adnexa could not be made out and no masses were palpable. Movement of the uterus was mildly painful, and there was a questionable tenderness in the right fornix. A diagnosis of an acute inflammation of a posteriorly located or retrocecal appendix was made, and operation decided upon.

On opening the abdomen some serous exudate was found. The appendix was normal and no Meckel's diverticulum was present. The right tube was swollen, tortuous and hyperemic, and its mucosa red and glistening. The right ovary and parametrium were congested. The left adnexa could not be brought into the field of vision and presented no changes appreciable

through palpation. The appendix was removed, the abdomen closed without drainage, and the patient made an uneventful recovery.

During the hospital stay and later on, repeated smears from the urethra and from the region of the cervix were made; these showed no gonococci, but numerous Gram-positive and some Gram-negative cocci and bacilli. In one fresh smear trichomonas vaginalis was found. The final diagnosis was "non-specific catarrhal salpingitis."

As far as I know, the patient has been well since leaving hospital.

#### COMMENT

I believe that the case described was one of the number in which the correct diagnosis of acute salpingitis cannot be made with certainty and a laparotomy is unavoidable. On account of the chronic course and the mildness of the infection, blood sedimentation tests would have been of little help in this particular instance.

In the meantime I had occasion to use the sedimentation test in a number of similar but more acute cases, and found it eminently reliable and of great practical value for differentiating between acute tubal infection and appendicitis.

In such cases as the one above described, even after the abdomen is opened, the inflammatory changes produced by the initial stages of acute salpingitis are not pronounced enough to be appreciable by palpation alone; the diagnosis has to be ascertained by vision, and eventually by culture of the tubal secretion. This may be one of the reasons why acute catarrhal salpingitis is seldom diagnosed in the numerous cases where a small abdominal incision is made for the removal of a suspected appendix, although the appendix is found to be not responsible for the symptoms. Possibly it would be more often diagnosed if in such cases the incision would be extended far enough to permit a look at the adnexa.

#### SUMMARY

Non-specific infections are responsible for acute and chronic salpingitis in a considerable percentage of the cases.

They can present a history and produce clinical and pathologic pictures similar to those of gonococcus infections. The resultant pathologic changes in the tubes often cannot be distinguished from specific lesions.

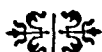
Non-specific salpingitis can occur without previous exposure and may be added to the swelling list of pelvic disturbances found in young girls, often mistaken for acute or chronic appendicitis.

There are unquestionably a few cases in which the differential diagnosis between acute salpingitis and appendicitis cannot be made with certainty, and where laparotomy becomes imperative.

If exploratory laparotomy reveals an acute tubal inflammation instead of the expected appendicitis, the best procedure theoretically would be to close the abdomen without further interference. Usually, however, the appendix can be removed without harming the patient. This procedure has also the practical advantage of saving surgeon and patient a possible repetition of the same dilemma of differential diagnosis and possible second operation.

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# A MODIFIED STURMDORF TRACHELOPLASTY

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**D**URING the past nine years I have been doing tracheloplasties by a modified Sturmdorf technique. It ends in the classical Sturmdorf method, thus coapting the surfaces more thoroughly; (b) the lower stitch further pre-

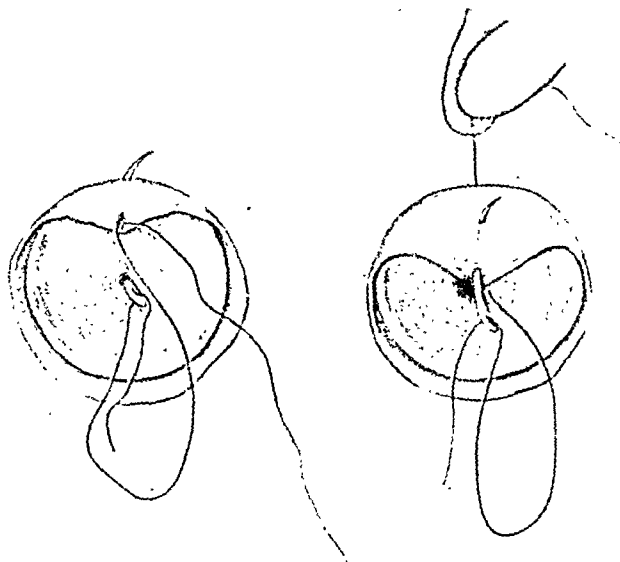


FIG. 1.

FIG. 2.

FIG. 1. Suture inserted at central point of flap, one-quarter inch or less from the edge and tied at its under surface. The end proximal to the cervical canal is now in the course of being passed through the canal at the level of the internal os to come out on the vaginal surface. (While this is being done, the flap is supported and traction made on it with an Allis forceps; this is not shown in the illustration.)

FIG. 2. First suture passed and held taut while the lower one is being passed about midway between the internal os and the newly formed external os.

differs from the standard method essentially in the fact that instead of transverse suture aspects being opposed and united with transverse suture aspects, in my technique, longitudinal suture aspects are opposed and united with longitudinal suture aspects. The practical differences and advantages are that in the longitudinal method, better results are obtained, because: (a) the inverting flaps, in view of their tapering points, can be drawn up to a somewhat higher level in the cervical canal than can be done with the transverse

cludes the possibility of any loose space where blood might accumulate or whence hemorrhage might take place; and (c) its execution is simpler and easier than the Sturmdorf method.

*Technique.* A cone is removed and a flap prepared as in the Sturmdorf method. Even after a curettage has been done, one must make sure that a sufficiently raw surface is created in the region of the internal os. This is accomplished with a scalpel used in a scraping rotary motion a few times. A suture is then passed through a central

point in the flap (anterior or posterior) one-fourth inch or less from the edge, and the ends tied at its undersurface (Fig. 1),

2 and 3.) Most of the time, particularly when a cervical wedge is removed with the apex terminating at the internal os, that is,

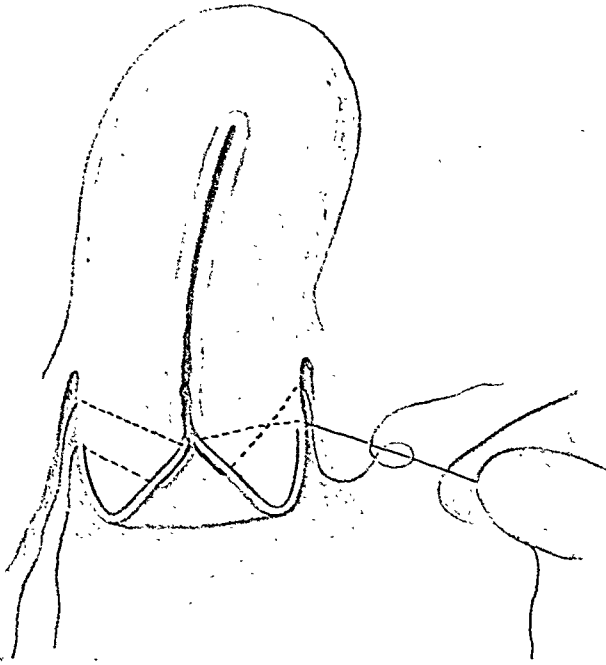


FIG. 3. Posterior segment shows the upper and lower sutures in place ready to be tied. Traction is to be made on the upper end with one hand while the other ties the knot. If traction is made on the lower or on both ends while tying, the desired result will not be obtained. Anterior segment indicates how traction on the upper or first suture, while inserting the second one, will cause the latter suture to come out higher than the first one. In this case traction must be made separately on both ends to determine which one invaginates the flap more thoroughly. The one that accomplishes this is held taut with one hand, while the other hand ties the knot.

both ends being left sufficiently long and uniform. While the flap is held steady with an Allis clamp (not shown in the illustration), the threaded end proximal to the cervical canal is inserted into the canal high up at the internal os and coming out on the vaginal surface. (Figs. 1 and 2.) While this end is being held taut (Fig. 2) so that the tip of the flap completely invaginates, the other threaded end is inserted similarly, but halfway between the internal os and the newly formed external os (Fig. 2), likewise coming out on the vaginal surface. When both flaps are thus treated, traction is made on the upper suture with one hand while the other hand ties the knot. (Figs.

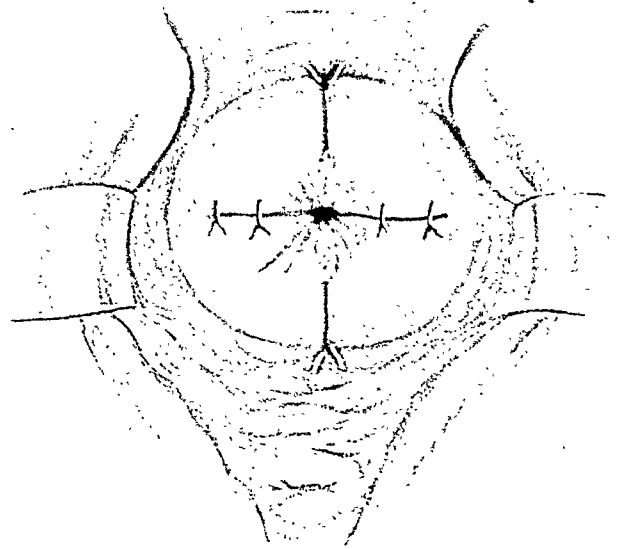


FIG. 4. The technique completed. The cardinal sutures are running in a longitudinal direction.

without leaving or making a shelf, and without making a flap as in the Sturmdorf technique, the second suture, while traction is being made on the first end, will come out higher on the vaginal surface than the first. (Fig. 3, anterior flap.) (This constitutes an important technical correction which cannot be done in the Sturmdorf method.) In this case, before attempting to tie the ends, it is necessary to use traction separately on both ends to determine which one inverts the flap more thoroughly. The one that does this better should be held taut with one hand while the other hand ties the knot. (Fig. 3.) It is needless to add that the flaps must be loose enough to facilitate invagination. The lateral sutures, when they are necessary, are inserted in the conventional manner. (Fig. 4.) Figure 4 also shows the cardinal suture appearing in a longitudinal instead of a transversal direction.

With this technique I obtain results as close as possible to a normal cervix. No complications, immediate or remote, have

been observed in operations performed in this manner.

#### SUMMARY AND CONCLUSION

A modified Sturmdorf tracheloplasty wherein longitudinal suture aspects are united with longitudinal suture aspects instead of transverse suture aspects. It has the advantage over the Sturmdorf method in that the inverting flaps can be drawn to a higher level at the internal os, thus precluding the possibility of loose or bleeding

spaces which might cause hemorrhage or disunion. Such preclusion is enhanced by the reinforcing middle suture.

The removal of the cone-shaped wedge without leaving sufficient tissue for a regular shelf is particularly indicated in deep and diffuse infections, permitting more of the diseased tissue to be removed; the employment here of the longitudinal suture technique yields better results than the Sturmdorf operation.

The execution of the modified technique is simpler than the Sturmdorf method.



THE operation for the plastic repair of a hard or soft palate cleft should not be performed before eighteen months and better results and a lower mortality are obtained by waiting until the second or third year, or even later.

From—"Pediatric Surgery" by Edward C. Brenner (Lea & Febiger).

# RECONSTRUCTION OF DEFORMED CHIN IN ITS RELATIONSHIP TO RHINOPLASTY

## DERMAL GRAFT—PROCEDURE OF CHOICE

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**C**ORRECTIVE rhinoplasty has come to be one of the most common procedures in reparative surgery. principle frequently results in a faulty post-surgical profile which is a source of much dissatisfaction to the patient.



FIG. 1. A profile definitely marred by an oversized nose in combination with a normally developed chin. Corrective rhinoplasty alone established normal proportion in profile. A, before and B, after operation.

With its growing popularity, however, attention is being focused on concomitant abnormalities of other components of the face and their relationship to the nose.

A reconstructed nose should not merely be inconspicuous; it should harmonize with the rest of the profile, particularly the forehead and chin. Failure to observe this

In outlining the correction, a sketch is often helpful. On it the surgeon can study the possible changes, visualize the future profile and determine the effect improvement of the nose will have upon the contour of the face.

Although it is obviously impractical to attempt to lengthen or shorten the fore-

head, rebuilding of the chin coincidentally with reduction of the nose is frequently indicated.

discussion of chin deformities without attendant functional disturbance.

The chin occupies the front plane of the

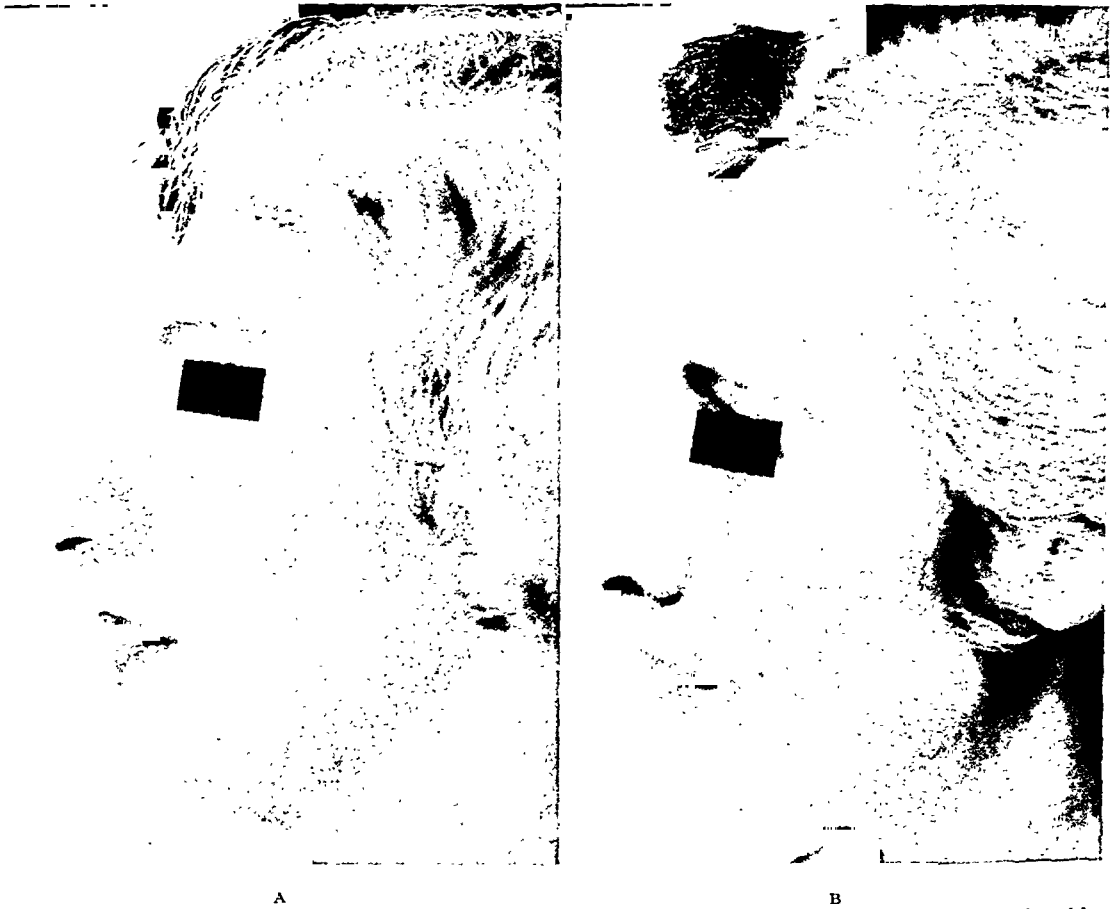


FIG. 2. Oversized nose and receding chin in girl of seventeen. Dermal graft used in rebuilding the chin. Rhinoplasty would not have been sufficient to establish an esthetic profile. A, before and B, after correction.

The most common types of chin deformities are the receding and the small or underdeveloped chin. In the majority of cases, these malformations are of congenital origin, but, a depressed chin may also be the result of injury, bony trauma in early childhood or scar formation. Scars around the chin, especially those which extend from chin to chest, cause pressure and interfere with normal bony development.

The chin abnormality may be traceable to pathologic factors by involvement of the jaw bones and teeth or ankylosis of the temporomandibular joint and malocclusion. Such malformations however, are comparatively rare and will not be covered here. Our report is confined chiefly to a

jaw and may be angular, rounded, protruding or receding; it may be overdeveloped or underdeveloped. Normally the chin falls underneath the vermilion border of the lower lip. The upper surface of the chin, which marks its depth, is convex and follows into the center of the lower lip. Thus the shape, form and size of the chin lend the face a characteristic expression of strength or weakness.

#### PROCEDURES IN USE

Normally the chin consists of a firm fatty cushion of varying size and shape, imposed upon the jaw bone. The material to be used for reconstruction must fulfill the local requirements, that is, it should be pliable

and of proper consistency. Where there is definite deficiency of bony development, a cartilaginous or bony graft is indicated. In the receding but otherwise normal bony chin, a soft graft is more suitable to complement the normal consistency of the padding. The choice of the plastic material is of importance in view of the cosmetic effect.

Some surgeons employ the ivory implant.<sup>1</sup> A dish-shaped ivory prothesis with multiple perforations is introduced through a small incision in the lower surface of the chin and maintained in a tunnel in front of the bony jaw. The implant is maintained in place partly by means of fibrous tissue growing into the perforations.

In my opinion, the ivory implant is unsuited to this purpose. For one thing, its hardness does not conform to the natural consistency of the chin. Principally, however, here as elsewhere an autoplasmic graft should always be given preference when possible.

While an iliac bone can easily be shaped to rebuild an underdeveloped chin, it is contraindicated in cases with a scanty elastic padding. The ease with which a rib cartilage graft may be shaped to fit the curvature of the chin renders it more suitable for this purpose than a bone graft. An additional advantage is its greater resistance to infection and absorption.<sup>2</sup> I have used rib cartilage in a number of cases with gratifying results. In many instances, however, the solid consistency is a decided drawback. The following is a case in point.

Several months after insertion of a rib cartilage graft, the patient, a young girl, complained of its hardness to the touch. Although she was satisfied with the post-surgical shape of the chin, she complained that her fiancé, unaware of surgical correction, commented on the hardness of the chin. This young woman became obsessed with the idea that the surgical camouflage might one day be discovered, and she insisted that the cartilage be removed and replaced by a softer material. We did so, employing a dermal graft. This was the

last case in which we used cartilage for a chin reconstruction.

Where rhinoplasty is done at the same



FIG. 3. The receding preoperative chin indicated in dotted lines. Dermal graft shown in solid line, placed anteriorly to chin to produce natural protuberance. There was no indication for lengthening the chin.

time as the chin correction, some surgeons advocate use of the osteocartilaginous hump removed from the dorsum to rebuild the chin. This method calls for the presence of a hump of considerable size, which is not always available. The procedure therefore seems feasible only in limited cases.

The fat graft has long been in use for filling out depressed areas on the face, it does not, however, possess the ideal requirements for an autoplasmic material. Its great fragility and marked tendency to absorption make it difficult to determine the necessary degree of overcorrection.<sup>3</sup>

Dermal grafts, comprising a full-thickness of skin without epidermis have been used abroad for many years in general surgery for the closure of hernias, reinforcement of joints, etc.<sup>4</sup> In the past few years



FIG. 4. Two photographs of the patient with the postoperative incision line marked by a dashed line and pointing along the direction of the incision. A line is drawn tangent to the incision line at the point of the chin, and a smaller incision is made along this line, the incision line. The incision line is made along the incision line. It is a preoperative photograph. The incision line is made along the incision line, and the incision line is made along the incision line. The incision line is made along the incision line, and the incision line is made along the incision line. The incision line is made along the incision line, and the incision line is made along the incision line.

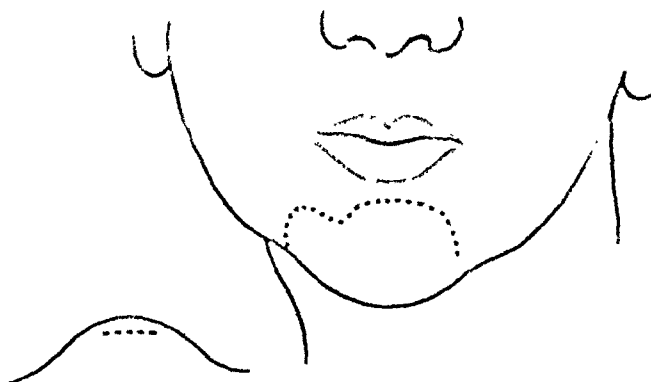


FIG. 5. Diagram at left shows location and length of incision through which a dermal or cartilaginous graft is inserted. The irregular shape of rib cartilage graft in upper sketch corresponds to asymmetry of chin as shown in photograph (Fig. 4).

I have used dermal grafts for filling out facial depressions with invariably good results. In my opinion it is the substance of choice in upholstering the facial contour. When inserted subcutaneously it preserves its integrity with minimum shrinkage and no untoward complications.

Our main objection to dermal grafts at first was the possibility of cyst formation due to the subcutaneous inclusion of skin appendages (hair follicles and glands). Experience proved, however, that these appendages atrophy and disappear after a time.<sup>5</sup>

Favorable experience with this type of graft in other facial defects led us to use it for building up the receding and undersized chin. Our results so far have been highly satisfactory to both the patients and ourselves.

A strong argument in favor of the dermal graft is its accessibility and greater resistance to infection. In a few cases we have seen dermal grafts partially exposed to infected wounds, heal in place without apparent damage.

The dermal graft can easily be prepared in the required size and shape and, if necessary, can be superimposed in layers. The graft shrinks slightly in time (10 to 15 per cent) and for this reason moderate overcorrection is indicated. However, there is much to recommend its use in preference to the fat graft, where a 50 to 60 per cent loss by absorption is not uncommon.

The nature of the material permits of exact affixation, thus eliminating the possibility of displacement of the graft in the reconstructed part. There is no tendency to lobulation, as in the fat graft; the transplanted derm becomes evenly incorporated in the surrounding tissues, showing a firm structure.

#### CONCLUSION

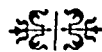
Reconstruction of the undersized chin coincidentally with reduction of the nose is often indicated, to establish a harmonious profile.

The most common types of chin deformities are the receding and small, or underdeveloped chin.

A cartilaginous graft is indicated in reconstruction of the underdeveloped chin; dermal graft is the substance of choice for the receding type.

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# THE CAUSES OF SURGICAL FAILURE IN CLEFT PALATE OPERATIONS

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A SURGEON is one who *looks in* and *finds out*. When he has ceased finding out, he has ceased to be a surgeon. "Experience," said Hippocrates, "is fallacious and judgment difficult." But, we may add that *experience*, based on a well cultivated habit of reflection, is the only sure way in which accurate *judgment* can be brought to bear the fruit called *wisdom*. We need, too, not only our own experience for the building up of knowledge, but that of other men in whom we have confidence, for our own experience may be so limited that it is practically worthless, but when added to the testimony of others, it may become crystallized into something useful. It was with these facts in mind that the present study was undertaken.

Blair of St. Louis, in his article on cleft palate in the National Encyclopedia (Collier & Co.) says that "staphylorrhaphy is one of the most difficult operations in all surgery." By this I feel sure that he does not mean the mere process of cutting and suturing, but the matter of getting a satisfactory result when healing is completed. Technically, the operation is not difficult—certainly not so difficult as submucous resection of the nasal septum in an old fracture, for example—but for many years, poor results have made the operation tabu to most general surgeons, and to not a few who restrict their surgical activities to work about the head. Some operators seem to have had a feeling that attempted repair of the palate is something worse than a waste of time. "Why bother with it?" said one, "You know you can't do these children any good."

It is with a view to finding out what a cross section of opinion might show if it

could be obtained from those surgeons who do such work frequently, that I felt it worthwhile to "sound them out" as to the causes of this alleged failure. Accordingly, personal letters were sent to a selected list of men practicing this sort of "plastic" in various large medical centers throughout the United States and Canada. Inasmuch as the questionnaire method of obtaining such information has been done to death, it was thought better to ask surgeons freely to express their opinions and experience, instead of setting questions for them to answer. The response was generous in the extreme; about 98 per cent of replies were received, which shows the great interest this topic arouses. Several of the correspondents wrote *in extenso*, and asked that, if they had not made their position quite clear, they be queried further to elucidate moot points. I would be more than ungrateful if I did not here express deep thanks for this splendid coöperation. The response was inspiring, and will, I believe, be definitely helpful. The following letter from Dr. G. V. I. Brown of Milwaukee illustrates the coöperative spirit which obtained:

"I am very much interested in the fact that you have undertaken to collect data for the study of the causes of failure following cleft palate operations, because I feel that you have taken up a phase of the subject which ought to have been studied in a systematic way long years ago.

"As a matter of fact complete failure following staphylorrhaphy ought to occur very seldom.

"In my private work, and in the clinics of which I have charge here at the Milwaukee Children's Hospital and at the Wisconsin General Hospital at Madison, we rarely ever

have a failure insofar as securing closure of the palate fissure may be concerned, and then, usually, because of something we have left undone that we ought to have done.

"I no longer look in the mouths of my patients constantly as I formerly thought I had to do, because we feel very sure of the results, and the less youngsters are disturbed the better.

"Judging by my own past misfortunes, and the results of previous operations by others as the patients have come to me later for correction, I would enumerate the causes of failure as follows:

"1. Failure to overcome and guard sufficiently against tension.

"2. Insufficient blood supply for the flaps.

"When the Von Langenbeck-Warren mucoperiosteal operation was performed, as I used to do it for many years, there was in some cases a more or less sufficient blood supply from the anterior vessels through the incisive foramina and the posterior palatine vessels, but raising the flaps by making an incision along the inner borders of the fissure took away the blood supply, and in cases where the tissue was not thick and well nourished, a partial failure through the formation of an opening in the center of the palate was unavoidable; unless great care was taken, failure of the sutures to hold the parts together was very likely to be much more certain.

"Looking back over the years, I feel that that operation made a good showing.

"The operation as I now perform it, by the formation of bone flaps, closing the posterior portion of the palate first, and one year later the anterior portion by raising mucoperiosteal flaps which are, however, small because the remaining anterior portion of the opening is usually very small, has given me results that I have never been able to obtain in any other way.

"The reason is that the plentiful blood supply from the nose is undiminished and the same blood supply that the other operations have depended upon is also effective here.

"Not only is mortality almost nil, but we do not have the high temperatures and the very sick babies we used to have.

"With the child in good condition and a plentiful blood supply, the mucous membrane of the mouth will clear itself usually very satisfactorily with but little postoperative treatment of any kind.

"On the other hand, when a child's general condition is poor, if for example, there is a tendency to acidosis, bacteria and secretions cling to the mucous membrane. Then, even the greatest care cannot clear the operative field sufficiently to keep the parts in good condition.

"3. Traumatization of tissue.

"Operators unaccustomed to working in the mouth always cause more damage to the tissue than experienced oral surgeons.

"I have seen operators damage tissue in the formation of flaps, so that looking on, one could be almost sure that these could not survive.

"4. Tying sutures too tight.

"Unless the parts can be brought together freely without tension, any attempt to hold them with tightly drawn sutures must fail. The sutures cut and pull out.

"5. The condition of the patient at time of operation.

"The child must be in as perfect condition as possible. I send every child from the table without operation who comes there with any condition out of the ordinary. If the trouble passes, they are brought back again. I know that I reduce mortality and also the number of sick postoperative infants that I would otherwise have.

"I congratulate you on the efforts you are making to investigate this feature of palate work, and would appreciate being informed as to the results of your research."

#### AGE

A wide diversity of opinion exists as to the age most favorable to securing a satisfactory result. This may be classified as follows:

(1) Do early; (2) too early; (3) too late; and (4) early and late.

The *early* operators advocate a range from seven days to two years. H. A. Potts would do the operation in the first week, or during the first two or three months. He agrees with the majority that harelip, if present, should be corrected before the palate operation, and that there should be a waiting period before the latter procedure, according to the will of the operator.

Risdon of Toronto likes to have the cases in hand somewhere between the

eighteenth and twenty-fourth month, while Baldwin of Columbus, Ohio, thinks that one year strikes a good average.

The *too early* objectors are notably Blair, Dorrance, Vaughan and Dunning. The latter says, "Most of the operations that are failures either are done too early or are badly planned." And Dorrance affirms that, "The older a child is, the thicker the tissues over the hard palate are," meaning by inference that thicker tissue is tougher tissue and more likely to withstand tension.

Ladd of Boston speaks of the undesirability of "postponing the operation until *too late* in life." This opinion is well supported by common experience and seems to be based upon the poor vascularity of the tissue commonly present in later life, upon the inadequate blood supply to the flaps, and upon a relatively insufficient amount of tissue which can be "borrowed" to close what is, in adults, a wide gap with narrow margins.

*Early and late:* Ivy of Philadelphia is the only author who happens to mention the range of age during which he has operated successfully. This covers a span from 2½ to 27 years! He uses the Veau and the Dorrance "push-back" technique.

"In this connection," says Dr. Herbert A. Potts of Chicago, "I think 2 or 3 months of age is the best time to operate a cleft. I do the lip first, or, if there is no cleft lip, I do the palate the first week, if I can.

"If I think the mucoperiosteum too thin, I pack it with vaseline gauze for two or three weeks, then operate on it. The patient should be in the best physical condition, with blood normal and gaining in weight.

"I am very careful not to traumatize the tissues during operation; to get no tension on the flaps, and to have irrigation after feeding, as well as before and after operation.

"I try to have the babies in the hospital three or four days before operation.

"To avoid a short palate I draw the palate upward and backward by means of

nasally placed sutures passing through the pharyngeal muscles."

#### GENERAL CONDITION

As might be expected, practically all operators lay stress on good general health as a prerequisite to successful repair. This holds especially for the ward cases, most of whom come from poor families and have, therefore, never known or enjoyed the regimen of food and living which those in better circumstances usually have had. Federspiel builds up the general condition for some time prior to operation, through food tonics and general hygienic measures. Risdon speaks of a "sugar diet" supplemented by a "milk mixture." He is probably thinking of younger children. Potts states that "the blood must be normal." I assume that he means a normal hemoglobin, differential and red cell count with a negative Wassermann. He is the only correspondent who mentions this extremely important item, but the others no doubt require blood examinations as a routine measure which is a part of the hospital "work-up." Vaughan, Davis and Brown emphasize good general health.

#### INFLUENCE OF HEALTHY RESPIRATORY TRACT

All membrane adjacent to the mouth should be as free as possible from infectious organisms. This dictum might be well summed up in the postulate: *Avoid infection, both pre- and postoperative!* Lyons states that "pediatrics plays a big part in the success or failure of this operation." Vaughan studies the nose and throat as well as the mouth, and is on the lookout for Vincent's organisms in any of these areas. He speaks of the importance of knowing the history of the individual as to high temperature, low resistance and the infectious diseases of childhood, especially of measles. Risdon names coryza and infectious diseases as enemies to success, and Blair puts the surgeon to the foil when he speaks of the "breath of the operator" as a source of postoperative

infection. Dunning sums the matter up in two words, namely: "avoid infection."

Prophylaxis of the nose, mouth and throat would seem to be a *sine qua non*, but the methods of bringing this about are not described by any of the correspondents. Federspiel says "Clean up the teeth and gums." Potts commands: "Prepare the patient for three days in the hospital before operation." Dunning avers that inexperienced operators are prone to use faulty methods, and that poor or bad planning makes for almost certain failure. Blair follows the plan of the late Dr. John E. Mackenty who warned against operating upon patients during the winter months when infections are prevalent. Since there is no emergency feature present, spring and summer may be recommended, and the reasons therefor stated when talking over the plans with parents who sometimes make up their minds suddenly and are likely to urge immediate operation while they are "in the mood."

Says Dr. William Ladd of Boston:

"Taking failure of union first, I would consider respiratory infections or middle ear infections as the most important and probably the commonest causes of failure of union. I state this because I find that patients who are in a private room have very few failures. I think I could take the last one hundred *private* cases and show that not over one or two have partially pulled apart. Neither the results of my associates nor my own results in the charity ward are as good as this. Though it is extremely uncommon, even in the wards, to have a complete failure of union, the last time I checked up there were something over 10 per cent of the cases who developed a small hole at the junction of the hard and soft palate, or a slight failure of union anteriorly. Not many of these hampered the eventual outcome, but a second operation was required. After respiratory infections, I consider the most important causes of failure of union to be interference with the blood supply by destruction of the posterior palatine vessels,

or by tying the sutures too tight, or using some form of tension apparatus. The latter we gave up many years ago. The flaps should be so free that tension apparatus is not required.

"Poor functional results I believe are largely due to failure in extending the lateral incisions far enough back, or to postponing operation until too late in life. I have done a few palate operations in the second decade which looked to me like splendid anatomic results, but the patients have never been able to speak worth two cents. The other bad functional results I see are in patients who have had two or three unsuccessful operations elsewhere, causing excessive scar tissue and preventing a flexible or mobile soft palate even after union is attained."

#### SOCIAL CONSIDERATIONS

Theoretically, there should be a difference in results according to the social status, a point which has already been touched upon, but several surgeons seem to think that this makes little difference. For example, Ladd obtains "good results" in 98 per cent of his private patients and 90 per cent in the ward cases. Vaughan, of New York, states: "I have almost completely eliminated failures by avoiding, as much as possible, the above factors." He names age, physical condition, presence or absence of infections, especially of Vincent's and measles, and faulty technique as the factors.

Dunning (New York) expects 95 per cent success in all of his patients, but it is assumed that he selects them with care. Dr. Dunning writes as follows:

"I am doing most of this work at the Medical Center and would say that we have very few failures in cleft palate operations. We ought to expect to get about 95 per cent success in the first operation. Most of the operations that are failures are either done too early or are badly planned; too much is attempted at one operation which is roughly executed; there is too much tension on the sutures; injury to the

blood supply; infection; poor postoperative care; and operations by the inexperienced who perform them only occasionally, and therefore are not quite up to the job."

#### TECHNIQUE

In the minds of most persons, laity and surgeons alike, there is a deep-seated feeling that "technique" is responsible for success in all operative work. That is, I think, a little too far reaching, for it exacts more from brain and hand than these should reasonably bear. Every surgeon feels sure that *his* technique is as perfect as it is humanly possible to make it, but, in the nature of things there is no 100 per cent of success over a period of years in any field of endeavor. We must deal with unknown elements, no matter how rigid our preparation, and surprise and disgust sometimes come to us from indeterminate sources.

However, there seems to be one text from which every surgeon wishes to preach a sermon, namely, *avoid surgical trauma!* These words occur again and again in the writings of all authorities on cleft palate surgery.

A second text might be propounded with the words, *conserve blood supply!* Occasionally, however, so little is thought of the importance of this dictum, that a recommendation is made to "cut the posterior palatine arteries." For example, Dorrance, who has written an excellent book on cleft palate surgery, does his operation in two stages. In the first stage he "divides the posterior palatine arteries"; in the second, he "waits for a thickening of the flaps." This seems to be another way of saying that after severing the arteries, one must wait for a reestablishment of collateral circulation in the flaps before utilizing them. Only those who have performed his "push-back operation" may pass judgment on this, but many who follow him, notably Burdick of New York, are enthusiastic. This was true of that excellent rhinolaryngologist, the late Dr. George Carroll of Rochester, who recommended

and performed the Dorrance operation in all cases.

As to conservation of blood supply, Dr. Chalmers J. Lyons (University School of Dentistry, Ann Arbor, Michigan) says: "We are emphasizing the conservation of all of the blood supply of the posterior palatine vessels. In the past, we have thought that there was an anastomosis between the posterior palatine vessels and the anterior. We have come to the conclusion after considerable investigation that, if there is an anastomosis, it is in the anterior palatine canal and does not come down onto the palate. We believe that the entire palate is supplied with blood from the posterior palatine. We have made some nice dissections to show this and to show that right at the junction of the hard and soft palates there are very few collateral vessels, and we believe that the reason one gets these post-operative openings is that there is a lack of blood supply to that part."

Federspiel (Milwaukee) is a conservative who opposes long lateral incisions, and he is upheld in this by many others. Ivy, of Philadelphia, uses the method of Dorrance of the same city, and also, at times, the Veau (Paris) technique.

Other advocates of conservation of the blood supply are notably Ladd, who cautions against an "interference with blood supply by destruction of the posterior palatine vessels," Federspiel who has seen "starvation necrosis from injured blood supply," Risdon (Toronto) who inveighs against the "cutting of arteries and destruction of the blood supply," and Dunning, who avoids "injury to the blood supply," without being specific.

As to "denudation" and preparation of the soft parts preliminary to actual suturing, Ferris Smith, of Grand Rapids, "splits the margins of the cleft and does little or no denudation." He relies on the placement of sutures to bring the raw edges together and thus effect permanent union. Davis, of Philadelphia, on the contrary, thinks that "failure is often due to insuffi-

cient denudation" and Blair of St. Louis blames "insufficient freeing of the tissues" for some failures.

However, the seemingly radical difference in these factors is not so great after all, for everyone knows that in order to get any union between mucous membranes, one must have a "raw" surface. The variation seems to depend upon the manner of making the surface raw. It is, of course, absolutely necessary to conserve every millimeter of tissue in a region where the width of the gap to be filled in often seems larger than the amount of "fill" to be obtained. Federspiel thinks that, "Failure following cleft palate operations is largely due to errors in technique, especially so when the circulation is disturbed sufficiently in the palatal tissue to cause starvation necrosis."

Then, of course, we must also take into consideration the resistance of the patient, and any systemic involvement that is a factor in preventing healing. Infections also play an important part, especially with patients who have decay of teeth, gingival pericementitis, periapical abscesses, etc.

#### SUTURES

Slight mention is made of the kind of suture material used by the correspondents. It seems to be taken for granted that either silk, horsehair, or linen is inevitable. Older writers were careful to explain that these fillets must be left in place much longer than the traditional five days allotted to skin incisions. Why? The limited experience I have had, supplemented by watching the postoperative progress in patients operated upon by others, leads me to believe that the purpose of sutures is served by the fifth day. Thereafter, a suture is a foreign body and, as such, is likely to *delay* healing rather than to *promote* it. Removable or non-absorbable sutures are not unattended with the risk of breaking down a part of the healing line, whether removal be done with or without general anesthesia. The stitches are likely to be encrusted with secretions from the wound edges plus

inspissated nasal and oral mucus, and are not always visible, since, even when black thread is used, it is decolorized within a few days.

What about chromic gut for this purpose? Personally, I have found it highly satisfactory, and feel sure that it is used by many operators who never emphasize the fact. The twenty-day variety of small size, number one or smaller, never larger, should be chosen. It should be softened by the nurse in order that its "looping" tendencies do not become an annoyance to the operator who already has enough to worry about in his hour and one-half of concentrated effort.

By the fifth day there is either cross union, or a pulling away of the edges of the midline. The latter denotes that the wound margins are healing together, but not across the gap as desired. The fillets are fairly loose by this time and are doing very little to keep the tissues in approximation. If gut has been used, it can be removed without difficulty, as it is partially digested and may not even require to be cut with scissors.

Regarding removal of sutures, Lyons, of Michigan, does this on the fifth day; F. Smith of Grand Rapids, on the sixth or seventh; and Logan, of Chicago, on either the ninth or eleventh day according to conditions. All operators are unanimous in urging that no tension be permitted, that sutures must not be tied too tight, and that inaccurate approximation must be avoided. Some do not favor lead plates or other means of taking the strain from the midline. It is difficult to find any good ground for objecting to this, for upon avoidance of tension on the suture line depends primary union or the lack of it. In retrospect, it seems to me that the Mackenty technique in this particular is not only serviceable but indispensable, and after following his cases, I decided to use lead bands in every instance.

Just a word about this. Small rectangles of lead about 1 inch wide, 3 inches long and  $\frac{1}{2}$  inch thick are procured, usually through

a hardware dealer. When needed they are hammered to the thinness of an ordinary sheet of paper. There is no good reason why they could not be rolled out in a machine, but we still seem to cling to this primitive method. They are sterilized by boiling for a half hour and may then be cut with scissors as required. Stab incisions are made through the soft palate on each side, just avoiding the posterior palatine vessels as determined by the hamular process which may readily be felt by the finger. These stab incisions are stretched with a hemostat until it is possible to pass a lead strip about 1 cm. wide through the incisions from side to side. The ends are not yet cut off, but the strip is kept from slipping out of place by sutures passed through and held to the cheek by ZO tape.

Another lead strip,  $\frac{1}{2}$  inch wide, is inserted through the lateral incisions about the center of the hard palate area. We are now ready to place the sutures. After they are tied, the ends of the lead strips are sewn together, leaving about  $\frac{1}{4}$  inch of the ends hanging free. This is of great value in keeping the tongue away from the suture line. Dr. Mackenty used a sort of basket-work applied to the teeth to keep the tongue away. This is quite unnecessary, as the sharp or rough edges of the lead strips soon educate the tongue to avoid the discomfort occasioned by this contact.

Dr. Fulton Risdon (Toronto) says:

"I, perhaps, use an older method, and that is lead plates over wires in the posterior palate region on each side, which I remove on the tenth day, not for tension, but for splinting the palate. My belief is that the long lateral incisions predispose to loss of circulation and failure. Further, it is very difficult to splint the palate with such long incisions. I am well aware that the lead plates have been given up quite largely by most men, but I still continue to use them with great satisfaction."

#### POSTOPERATIVE CARE

In general, it seems better not to do too much postoperative meddling. But the mouth as a whole should be kept as clean

as possible, consistent with no disturbance of the suture line. Ferris Smith (Grand Rapids) believes in a policy of "hands off," while Dunning (New York) thinks that poor postoperative care is the cause of some failures. Davis (Philadelphia) believes in "cleansing the suture line" as do several other correspondents.

Whatever is done should be carried out by the operator himself. It should not be delegated to a nurse or house officer, for this is no place to divide responsibility. Some prefer saline irrigations to nose and throat, avoiding contact with the sutures. It is doubtful whether this is possible. Certainly no "scrubbing" with a bit of cotton or gauze should ever be done, for it does no good at all, and is a bid for failure. Personally, I drop a solution of 50 per cent hexylresorcinol through the nose and along the suture line of the oral side, but the tip of the dropper never comes into contact with anything. Maybe it does no good, but I feel that it does no harm. In this connection, the method of feeding is of great importance. The end of a spoon or the nipple of a milk bottle, even nursing at the mother's breast, may spoil our work. It is better to give liquid food only through the nose via a soft rubber catheter which is passed close to the septum and rather high in the nose away from the palate, the tip reaching just to the oropharynx. Only a few drops should be sent through at a time so that coughing or strangling will not take place. This is a laborious procedure, but should be carried out for the first five days in all cases of children under 5 years of age. Thus given, food does not contact the suture line to form a nest for bacteria.

Dr. Vilray P. Blair of St. Louis says: "I think the following are causes for failure in cleft palate operations: too early operations; insufficient freeing of the tissues; inaccurate approximation with sutures; destruction of blood supply by cutting the lateral arteries; and, most common of all, infection.

"Infection can come either from an ordinary cold, or most commonly, from the breath of the operator. I think we have

somewhat lessened our infections *by not operating on cleft palates between the first of January and warm summer weather*, since that is the time upper respiratory infections are most prevalent. The interoccurrence of measles, whooping cough, pneumonia, etc., will interfere with healing. Any child who has a temperature over 103°F. two days after operation is apt to have a hole in the palate.

"Any man who reports no failure either does not operate on many palates or takes liberties with the exact truth."

#### GOOD OPERATIVE RESULT WITH BAD FUNCTION

Not infrequently, a fine surgical result is associated with a stiff palate, excessive scar tissue and rhinolalia; therefore, the importance of educating the palate muscles to their new duties in the formation of correct speech must be emphasized. This is another reason for doing the operation before speech habits are formed, for it is so difficult to change habits that are deep-seated or long continued. Baldwin (Columbus, Ohio) says that, "If done after talking age, the operation results in poor speech." This is a common observation; therefore, speech training is imperative in every case, whether the operation be done early or later. There are, in most towns of any size, teachers who work privately or in connection with public schools, who take great interest in this matter of speech improvement and who are very assiduous and successful in obtaining results. It is, to be sure, a highly specialized form of pedagogy, requires no end of patience, and is commonly not well rewarded. All honor to those teachers who toil so indefatigably in helping these children to a normal place in society.

In olden times, it was thought that cleft palate children were stigmatized not only through physical defection, which is always apparent to the ear after speech is attempted, but also through mental defection as well. Nothing can be further from

the truth. Many of these unfortunate children are bright, wholesome and affectionate. However, they are soon made to feel their "unlikeness" to normal children, and therefore develop an inferiority complex which makes them seem stupid, slovenly or ill-tempered, and consequently, is likely to make them socially dependent. A successful operative attack may convert them into fine, upstanding, independent citizens. Is there a more worthy objective in all surgery? Certainly, it is far more likely to be successful than many of the operations on the brains of mental defectives who must, of necessity, be substandard, no matter how self-righteous the well intentioned surgeon may feel in his effort to bring forth salvage from the human rubbish heap. Staphylorrhaphy is now on a sound surgical footing, and this little investigation brings to light the intense interest of the oral plastic surgeon, and the joy he feels in his great work.

#### SUMMARY

Many physicians feel that attempts to repair a palate cleft are a waste of time because of poor results. There are, of course, some failures in spite of improved technique. What are the causes of these failures? To determine these, personal letters were sent to the leading men who do this work.

A cross-section of opinion seems to point to: improper selection of cases; operating in the presence of recent mucous membrane infections; cutting off of blood supply to flaps; incomplete preparation of "raw edges" of flaps; improper suture material; improper placing of sutures; too much meddling after operation, or neglect of proper postoperative care; good anatomic result with poor function; lack of speech training when healing is completed.

In general, the results are much better than they were twenty-five years ago. Some operators have, in fact, almost a perfect score. It is to these men that we must look for guidance in perfecting our technique.



# OPERATIVE MANAGEMENT OF TRAUMATIC INTRACRANIAL HEMORRHAGE\*

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ALTHOUGH the majority of patients with head injury do well on conservative treatment, a goodly number present signs and symptoms that may spell operative intervention. With the present day tendency of over-conservatism in the management of head injury it is important to evaluate such signs and symptoms and effect operative intervention as soon as it is justifiable or necessary. It is always a painful experience to note at autopsy a pathologic condition which could have been treated by operation with fair degree of probability for a successful outcome.

The pathologic possibilities in traumatic intracranial hemorrhage are given in the following tabulation:

- I. Intracranial hemorrhage
  - A. Extradural, due to rupture of meningeal vessels, sinuses and diploe
  - B. Intradural, due to pial tears, bruises or laceration of nervous tissue
    - (1) Subdural
      - (a) Acute
      - (b) Chronic subdural hematoma
    - (2) Subarachnoid
      - (a) Generalized
      - (b) Localized
    - (3) Intraparenchymatous
      - (a) Petechial
      - (b) Massive
- II. Bruising or laceration of nervous tissue, with or without fracture of the skull.

## III. Subdural accumulation of spinal fluid simulating intracranial hemorrhage.

In the above classification of listed conditions best treated by operation are extradural hemorrhage, acute subdural hemorrhage with signs, chronic subdural hematoma and subdural collection of spinal fluid. Because of similarity of symptoms and signs, some cases on exploration may show only contusions and lacerations of neural tissue or a wet brain with no demonstrable gross pathology. It must be admitted that in a great many there may be a combination of lesions.

This paper is based on eighty-one operated cases during a five and one-half year period from September 1930, to March 1936. I have included in this group only those cases which were treated by myself, and have not attempted an all-inclusive statistical survey. The distribution of pathology is as follows: 19 cases with extradural hemorrhage; 11 cases of acute subdural hemorrhage; 13 cases of chronic subdural hematoma; 13 cases of subdural collection of spinal fluid; 15 cases of wet brain, cerebral contusions, subarachnoid hemorrhage (any one or a combination of all). Before discussing these pathologic entities, I should like to consider briefly the various signs and symptoms in head injury which spell operative intervention. These may be grouped under the following headings: first, changes in the state of consciousness; second, changes in vital functions; third, changes in pupillary size and ocular function; fourth, abnormal

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(including normal spinal fluid pressure). Such a case is kept under close observation for other signs of increased intracranial

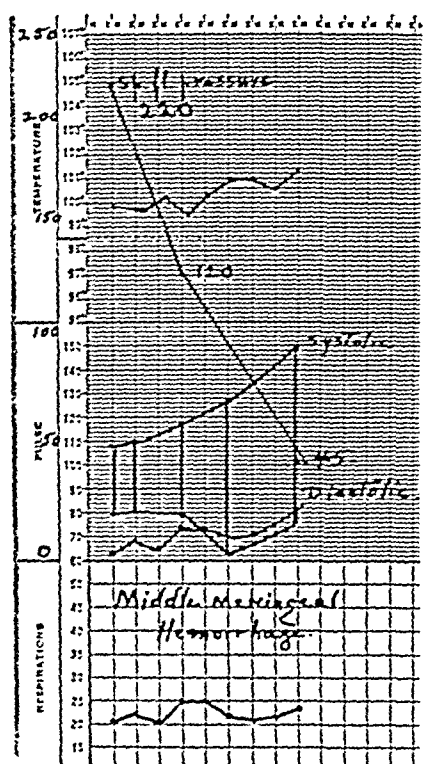


CHART III. A typical case of chronic subdural hematoma which has been allowed to go too long. There is increase in temperature, pulse and respirations. There is also a definite increase in the spinal fluid pressure. At this stage the patient is usually unconscious and may or may not have localizing signs. The presence of increased spinal fluid pressure in an otherwise normal person (except for the state of unconsciousness) is very suggestive of chronic subdural hematoma. A history of injury to the head may or may not be obtained.

pressure. Usually the pulse rate rises to normal from a few to ten days. Of course the mere presence of a low pulse rate is not an indication for operation, but a lowering rate is an important factor in establishing its advisability. In conjunction with other findings (such as increasing drowsiness) it becomes a potent factor favoring intervention.

The respiratory rate and the temperature are more frequently of prognostic significance. Increase in respiration soon

after trauma spells very poor prognosis. High temperature (above 104 degrees rectally) soon after trauma, is also of serious import.

I have found blood pressure readings of no significant help in estimating the degree of intracranial pressure. On the whole, blood pressure readings are worthwhile only to establish the condition of circulation. One type of blood pressure reading has been found to spell very poor prognosis in the adult, i.e., when the pulse pressure equals the systolic pressure.

3. *Changes in Pupillary Size and Ocular Function.* The condition of the pupils, their size, their reaction to light and inequalities, if present, are important both from a prognostic and a diagnostic standpoint. A dilated pupil is practically always on the same side as the lesion, for which an operation may be contemplated. However, in a small number of cases, the dilated pupil may be found on the opposite side, as was true in one of our cases of middle meningeal hemorrhage. Extraocular paralysis, when present, usually means pathology on the same side, when an operation is contemplated.

The prognostic significance of pupillary findings cannot be denied. Dilated and fixed pupils spell grave outcome. The same is to a less degree true in cases of constricted and fixed pupils. However, one can usually tell from the general appearance of the patient that he is in grave danger and such pupillary findings are therefore corroborative.

The presence of pupillary inequality as such is not a criterion for operation. When it appears in a case with other symptoms and signs favoring intervention, pupillary inequality helps to locate the pathology more accurately.

4. *Neurologic Findings.* Neurologic findings when present serve two purposes: first, the localization of pathology, and second, on the basis of the mode of development of such findings, they serve as indication for operative intervention. Hemiplegia, hemiparesis, Jacksonian convulsions, and

sensory changes, when detectable, usually denote pathologic changes in a definite portion of the nervous system. However, because of the great incidence of contrecoup lesions in head injury, neurologic findings of exact localization are at times quite misleading. Hemiparesis or hemiplegia on the same side as the cerebral clot

different significance from a hemiplegia developing slowly and becoming complete within twelve to twenty-four hours. In the former, the hemiplegia is most probably indicative of contusion or laceration of the motor cortex. When hemiplegia develops slowly, the possibility of an enlarging clot as a causative factor is apparent. Hemi-

TABLE I  
SYNOPSIS OF CASES WITH MIDDLE MENINGEAL HEMORRHAGE (OPERATED)

No.	Age	Pupils	Extra-Ocular Palsies	Lucid Interval	Pulse Rate	Focal Signs	Spinal Fluid	Results
1	55	Equal	None	None	50-60	Bilateral Babinski	Bloody 350	Recovered
2	13	At first unequal left larger	None	7 days with periods of disorient. No unconsc.	50-55	Right Babinski Right upper limb paresis	Bloody 180-300	Recovered
3	34	Right larger	None	None		Left hemiplegia		Recovered
4		Equal	None	None		None		Recovered
5	22	Constricted on same side	None	About 15 hr.	55-60	Right hemiparesis	Bloody 350	Recovered
6	34	Right larger	None	None	Normal	Left Babinski		Recovered
7		Right larger	None	None	55-60	Left hemiplegia	Bloody	Died
8	41	Left larger	Lt. 3rd	None	50-60	Right hemiparesis		Recovered
9	8	Right larger	Lt. 3rd	14-18 hrs.	55-60	Left hemiparesis		Recovered
10	26	Right larger	Rt. 3rd	12-14 hrs.	120-130	Bilateral signs		Recovered
11	11	Right larger	None	2 hrs.	50-60	Left hemiplegia Bilateral Babinski		Died
12	46	Right larger	None	Drowsy throughout	Normal	None		Recovered
13	54	Right larger	None	Drowsy throughout Disorient.	Normal	Left Babinski		Recovered
14	10	Left larger	Lt. 3rd	10-12 hrs.	45-60	Right hemiparesis	Bloody 600	Recovered
15	36	Right larger	None	31 days with periods of disorient.	Normal	Left hemiplegia		Recovered
16	53	Right larger	None	Drowsy throughout	60-65	Left hemiplegia		Recovered

Note that in three cases operation was performed seven, nine, and thirty-one days after accident, respectively. The pulse rate is uniformly low in the greatest majority. Focal signs were present in fourteen cases. Dilated pupil on the side of the lesion with paralysis of the opposite half of the body was present in thirteen cases.

is seen with sufficient frequency to warn the physician of its possibility. That such a state may be brought about is to be explained on the basis of either a contrecoup involvement of the cortex on the opposite side by pressure from the enlarging clot, or more frequently by contrecoup lesion of the cortex at the time of the accident.

In the greatest majority, the presence of a definite neurologic finding as such is not an indication for operation. The mode of appearance of said neurologic finding is much more significant. Hemiplegia seen immediately following an accident has a

plegia caused by contusion and laceration of motor centers appears immediately after injury. A combination of minor contusions of the motor centers and edema of the brain due to head injury may give the picture of a progressive paralysis. However, the spinal fluid in such a case is bloody and its pressure is not so high as in cases of extradural or subdural hemorrhage.

5. *Changes in Spinal Fluid Findings.* Spinal fluid findings are very important. The blood content of the spinal fluid is of prognostic and diagnostic significance. Bloody spinal fluid does not rule out an extradural hemorrhage of benign propor-

tions. In all cases of middle meningeal hemorrhage in this series spinal puncture when performed yielded bloody fluid. Of course, when the fluid is markedly bloody, the possibility of associated brain damage with massive intracerebral hemorrhage should be kept in mind. Bloody spinal fluid

TABLE II

## MIDDLE MENINGEAL HEMORRHAGE (OPERATED CASES)

State of Consciousness	
Lucid interval.....	6
Unconscious throughout.....	7
Drowsy with disorientation..	3
Pupils	
Large on same side.....	13
Large on opposite side.....	1
Equal.....	2
Extra-Ocular Palsies	
Third.....	4
Fourth.....	1
Sixth.....	1
Focal Signs	
Present.....	14
Not present.....	2
Vital Functions	
Pulse.....	45-60
Respirations.....	18-26
Temperature.....	100-102
Spinal Fluid Findings	
Pressure.....	300-650
Bloody.....	In all 5 cases punctured
Results	
Recovered.....	14
Died.....	2

Note that in cases of middle meningeal hemorrhage, lucid interval occurred in not more than 40 per cent. There was one case with a dilated pupil on the opposite side. Third nerve paralysis on the same side as the clot occurred in four patients. Focal signs were present in fourteen. Respirations and temperature were within normal limits, usually with a low pulse rate, certainly in the beginning. Spinal fluid pressure was uniformly high and the spinal fluid was bloody in each instance. The presence of bloody spinal fluid should not deter operative intervention in cases of middle meningeal hemorrhage. The tendency to attribute the clinical findings in the case to subarachnoid hemorrhage is to be deplored.

does not rule out chronic subdural hematoma. In a goodly number the fluid was either bloody or xanthochromatic.

Spinal fluid pressure obtained by water or mercury manometer is frequently of deciding significance. The pressure is always high particularly early in operative conditions excepting where operation is indicated for mechanical defects (simple and compound depressions). Fluid pressure of 300 and over is significant. In cases where the

spinal fluid is definitely bloody with pressure varying between 200 and 300, the possibility of cerebral contusions and pial tears causing the increased fluid pressure is apparent. Such pressure invariably drops down as the patient slowly recovers. In case of an operable condition, the pressure stays up or goes higher, except when the patient is very ill. A pressure of 150 is compatible with middle meningeal hemorrhage. This was true in one of our cases.

Extremely high spinal fluid pressure (750 plus) tends to become lower in patients who are progressively getting worse, as is well brought out by Browder and Meyers. At times a subnormal spinal fluid pressure is obtained in a patient who is evidently fatally ill. It is difficult to explain such low pressure, particularly in the presence of marked cerebral damage as shown by bloody spinal fluid. Possibly it is due to a deranged circulatory mechanism in the nervous system even though the general body circulation may be working at par or above par.

In patients who remain drowsy or disoriented for days or weeks, the presence of high spinal fluid pressure (300 and over) is a strong argument in favor of operation. In such cases, chronic subdural hematoma and occasionally an extradural clot may be uncovered.

*Summary of Signs and Symptoms.* It is evident from the above discussion that a combination of signs and symptoms may spell operative intervention. For example, low pulse rate of itself is not as significant as when associated with increasing drowsiness. With constant attention to the patient's condition and its varying manifestations, one usually arrives at a sane conclusion as to the proper procedure. It should be emphasized that each case of head injury should be individually treated on its own merits. There is sufficient variation in the manifestations of the pathologic processes to make a routine policy worthless. This will become more evident in the following discussion of extradural hemorrhage, acute and chronic sub-

dural hemorrhage, subdural collection of spinal fluid and certain cases of contusions and lacerations of the brain.

#### EXTRADURAL HEMORRHAGE

Extradural hemorrhage may be brought about by bleeding from bone, sinuses, meningeal vessels and emissary veins. Diploic bleeding is not usually of sufficient size to cause symptoms. We have seen fairly large extradural clots from rupture of the occipital emissary vein with depressed fracture in this vicinity. In none were there evidences of pressure symptoms from the clot. As a rule a discussion of extradural hemorrhage implies the group with bleeding from the middle meningeal artery. In the present series sixteen out of nineteen cases had rupture of the middle meningeal artery, two had rupture of the anterior meningeal and one was associated with tear of the lateral sinus.

In the typical case, the diagnosis of middle meningeal hemorrhage is easy. The usual story of head injury followed by a period of lucid interval which is then followed by progressive drowsiness, dilated pupil on the same side and evidences of paralysis on the opposite side makes the diagnosis a simple one. However, such a history may obtain with other than hemorrhage from the middle meningeal artery. We have seen this syndrome with acute subdural hemorrhage, edema of the brain and subdural collection of spinal fluid.

The absence of lucid interval is no argument against the diagnosis of middle meningeal hemorrhage and in some cases of benign outcome. The lucid interval is present if the hemorrhage is slow and there is no associated severe brain injury. It may be absent if the hemorrhage is very rapid, causing death two to three hours following the accident, or if there is associated severe brain damage. Marked disorientation alternating with lucid interval was observed in three cases. These people were operated on six, eight, and thirty-two days after the accident, respectively.

Dilated pupil on the side of the lesion associated with paresis or paralysis of the opposite half of the body was observed in twelve of sixteen cases. In three the pupils were equal and in one case the pupil was larger on the opposite side. In the latter, the hemiparesis pointed to the lesion on the side with the constricted pupil. Extraocular palsies were present in four of sixteen cases. It is reasonable to assume that the presence of such a palsy implies a more basal hemorrhage with the arterial tear in the vicinity of the foramen spinosum. With hemorrhage in this situation there is greater likelihood of implication of extraocular nerves as they course through the superior orbital fissure. Hemorrhage arising from rupture of the posterior branch of the middle meningeal artery compresses the lateral surface of the hemisphere and it is not usually associated with extraocular palsy. With tear of the posterior branch, there is greater likelihood of pupils equal in size. Hemiplegia or hemiparesis was present in fourteen of sixteen cases.

In an earlier communication, we discussed the similarity of Weber's syndrome (alternating oculomotor paralysis) and some cases of middle meningeal hemorrhage. This syndrome was seen in four cases. Each had third nerve palsy on the same side as the lesion with paralysis or paresis of the opposite half of the body. It is important to note this similarity, for the location of the lesion as described by Weber in cases of alternating oculomotor paralysis is in the midbrain, whereas, these cases of extradural hemorrhage proved beyond doubt that such a syndrome may be brought about by an enlarging clot above the tentorium. The third nerve paralysis is brought about by pressure against the third nerve in its course through the superior orbital fissure and the enlarging clot at the same time causes a paresis or paralysis of the opposite half of the body by pressing against the motor cortex.

Subdural hemorrhage caused by rupture of the middle meningeal artery internal to the dura was seen in one case. There was

also an extradural clot in this patient. The possibility of massive subdural hemorrhage from rupture of the middle meningeal artery internal to the dura is well admitted,

such example but we have seen three others in cases which were not operated on. In one case, this temporosphenoidal clot weighed between 35 and 40 Gm.

TABLE III  
OPERATED CASES OF CHRONIC SUBDURAL HEMATOMA

Case	Etiology	Ocular Changes	Fracture of Skull	Focal Signs	Location of Hematoma	Spinal Fluid	Operation	Results
1. C. G.	Auto	None	No	Aphasia. Left hemiparesis	Left		Left subtemporal decompression	Recovered
2. J. R.	Boxing	None	Yes	Right Jacksonian once	Left	350 clear	Bilateral trephine	Recovered
3. H. C.	Hit on head	None	Yes	Headaches, more to the left	Left	450 clear	Bilateral trephine	Recovered
4. J. D.		Right pupil dilated	No		Right		Right subtemporal	Recovered
5. F. F.	Football	Choked discs	No	None	Left	400 clear	Left trephine	Recovered
6. J. L.	Rocked on chair falling backward	Right pupil larger	No	None	Right		Right subtemporal Left trephine	Recovered
7. L. G.	Fight	Left 3rd	Yes	Right hemiparesis	Left	370 slightly bloody	Left subtemporal decompression	Recovered
8. E. N.	Auto	None	Yes	Left hemiplegia	Right	450 clear	Bilateral subtemporal depression	Recovered
9. J. O.	Auto	None	Yes	Left hemiparesis	Right	400 clear	Bilateral decompression	Recovered
10. C. R.	Shot	None	No	Aphasia, right hemiplegia	Left	Bloody increased pressure	Left subtemporal decompression	Recovered
11. E. D.	Fight	Left pupil larger	No	Suggestive right hemiparesis	Left	400 clear	Left subtemporal	Recovered
12. M. O.	Fight	None	Yes	Right hemiparesis	Left	450	Right trephine Left decompression	Recovered
13. C. O.	Auto	None	Yes	Aphasia	Left	300 slightly bloody	Right trephine Left subtemporal	Recovered

Among the operated cases of chronic subdural hematoma ocular manifestations occurred among five out of thirteen. There was fracture of the skull in seven cases. The site of the fracture does not necessarily indicate the side on which the clot may be found. The focal signs were frequent in this group but in a certain number some of these signs had disappeared completely by the time the patient entered the institution for treatment. For instance, although Case 2 had a Jacksonian epilepsy, this occurred only once and for several weeks he complained of severe headaches and at times became stuporous. The spinal fluid findings showed increased pressure in every one of the cases punctured. Xanthochromatic or bloody spinal fluid was obtained in three cases.

but this is undoubtedly a rare occurrence. A serious complication of middle meningeal hemorrhage is an occasional massive clot in the temporosphenoidal lobe on the same side. In the operated group there was one

The general appearance of the patient is of great importance. In the absence of severe associated brain damage, patients with middle meningeal hemorrhage usually do not look very ill. The pulse rate is almost

always low in the beginning. The respirations are not elevated and temperature reads between 100 and 102 rectally. The onset of symptoms is gradual, the patient showing more signs with every elapsed hour or more. The gradual onset of signs and symptoms is an important diagnostic criterion, although we may occasionally get the same picture with acute subdural hemorrhage or edema of the brain.

At times the position of fracture is of localizing significance, although in the

Slightly bloody spinal fluid or severely bloody spinal fluid does not rule out middle meningeal hemorrhage. All but one of the punctured cases recovered.

Table IV gives a summary of the cases as well as the signs and symptoms shown. Of great interest is the relative infrequency of lucid interval. It is also significant to observe that in a few patients disorientation alternating with periods of lucidity was the paramount change in state of consciousness. It may be assumed that

TABLE IV

FOCAL SIGNS IN OPERATED CASES OF ACUTE SUBDURAL HEMORRHAGE, SUBDURAL COLLECTION OF FLUID, EDEMA AND CONTUSIONS OF BRAIN

	Acute Subdural Hemorrhage	Subdural Collection of Spinal Fluid	Edema of Brain Cerebral Contusions and Subarachnoid Hemorrhage
No. of cases.....	11	13	15
No. of deaths.....	5	6	8
Dilated pupils.....	5	5	5
Hemiparesis or hemiplegia.....	5	4	7
Convulsions			
Jacksonian.....	2	2	2
Generalized.....	0	0	1
Lucid interval.....	2	2	2
Continued unconsciousness and disorientation...	4	4	
Dilated pupil with contralateral paralysis or paresis	4	2	3

It is to be noted that lucid interval occurred in two cases with each of the conditions above enumerated. Dilated pupil on the side of the lesion with hemiparesis or hemiplegia of the opposite half of the body occurred in four cases with acute subdural hemorrhage, two cases with subdural collection of spinal fluid and in three cases with edema of the brain, cerebral contusions and subarachnoid hemorrhage. Continued unconsciousness and disorientation was frequently seen among cases with acute subdural hemorrhage and subdural collection of spinal fluid. Jacksonian convulsions were frequent in this group. Although the signs seen in this group may simulate cases of extradural hemorrhage, patients with the latter condition usually look much better certainly in the earlier stages of the disease.

greatest majority the diagnosis should be made on the basis of signs and symptoms. If the head is explored on the side of the fracture shown in the x-ray and no pathology is discovered, it is justifiable to explore the opposite side. The spinal fluid examination shows high pressure ranging between 300 to 650 by the water manometer. The fluid is bloody in each case punctured, usually mildly so. In one of our cases it was very bloody, but this patient had an associated intracerebral clot in the temporosphenoidal lobe on the same side.

among these, the bleeding is sufficiently slow to allow the brain to compensate for space occupied by the clot; hence the absence of motor phenomena and period of lucidity followed by unconsciousness.

The operative technique and the methods used in the treatment of middle meningeal hemorrhage are removal of the clot through subtemporal decompression or osteoplastic flap. Either is preceded by an initial exploratory opening just in front and above or just behind and above the ear, or both. The use of a flexible brain



spatula of proper dimensions is worthwhile in that it may be introduced in the epidural space and thus a fairly large area may be

packing is removed during the following two days.

#### CHRONIC SUBDURAL HEMATOMA

Although a history of minor head injury is frequent among cases of chronic subdural hematoma, the association of this condition with severe brain injury and fracture of the skull has been repeatedly described in the past few years. In the present group of thirteen cases, seven had fracture of the skull. Undoubtedly the reason for such preponderance of associated fracture in this group is due to the rather large fracture service at the Receiving Hospital in Detroit. When chronic subdural hematoma complicates skull fracture with brain injury, a long drawn out state of drowsiness, disorientation, or both may ensue. In such instances there may be drowsiness or disorientation for weeks or months, and patients may even die if the chronic subdural hematoma is not suspected or treated.

Focal signs were present in a great many in this group. Among ocular manifestations, dilated pupil on the side of the lesion was seen in three, third nerve palsy in one, and choked disks in another. Localizing signs were absent in four cases. The most characteristic finding was headache, and this was practically always lateralized. In two cases definite remissions occurred. The latter occurrence is significant in that chronic subdural hematoma is not always characterized by progression of symptoms and signs. In two cases in this series, the psychic manifestations were the most important symptoms. That patients with chronic subdural hematoma may be sent to insane asylums as mental cases has already been emphasized in the literature.

The spinal fluid findings were indicative of high pressure, ranging between 350 and 450 mm. of water. In three cases the spinal fluid was bloody. Bloody or xanthochromatic spinal fluid does not rule out chronic subdural hematoma.

As concerns cases of fracture of the skull who do not recover properly and remain



FIG. 1. Clot due to middle meningeal artery rupture obtained through an osteoplastic flap. With this procedure a more complete evacuation of the clot is possible.

inspected. If necessary bilateral trepanation may be resorted to. This was necessary in one of our cases.

We have used general anesthesia more often, assuming that increased intracranial pressure caused by the anesthetic may accelerate the obliteration of the epidural space and minimize postoperative bleeding. Careful work is of course important, but speed is a definite criterion in the results obtained. These patients are usually on the verge of shock, and long drawn out operative technique will not help in the majority. After removal of the clot the bleeding vessel, if found, is ligated. We usually pack the epidural space loosely with iodoform gauze which controls bleeding and cuts down operative time. The

disoriented or drowsy for several weeks, the important thing to remember is that there may be a complicating chronic sub-

that we have found the hemorrhage on the same side, on the opposite side, and in one case associated with an occipital fracture.



FIG. 2.

FIG. 3.

FIGS. 2 AND 3. Clots obtained from patients shown in Figures 6, 7, 8, and 9.



FIG. 4. Shows clot evacuated from epidural space thirty-one days after the accident. In this case the bleeding must have been very slow with gradual receding of the brain to allow for space occupied by the clot. Patient had left hemiplegia with periods of disorientation and drowsiness. The removal of the clot was followed by complete restoration of function to the left half of the body.

FIG. 5. This clot was obtained in a patient with a dilated pupil on the opposite side.

dural hematoma. The most important diagnostic criterion in such a case is increased spinal fluid pressure. The site of fracture is of no localizing significance in

When chronic subdural hematoma is suspected, it may be ruled out by either encephalography or exploratory trephine openings on both sides of the skull.

Organization of the clot in the subdural space is begun immediately and evidences may be seen under the microscope in less than twenty-four hours. In a case of acute subdural hemorrhage from boxing, organi-



FIG. 6.



FIG. 7.

FIGS. 6 AND 7. A case of middle meningeal hemorrhage with third nerve paralysis. Recovery of oculomotor function usually obtains in three to five weeks after operation. The pupil on the affected side usually remains larger for a longer period. Eventually reaction to light and in accommodation obtains.



FIG. 8.



FIG. 9.

FIGS. 8 AND 9. Middle meningeal hemorrhage with right third nerve paralysis. In this case the pupils became equal three months after operation.

zation from the dural side was evident in sixteen hours. This organization can only obtain on the dural side, whereas, due to

operation, this opening into the subdural cyst is sealed off, thus bringing about the same physical and chemical relationship

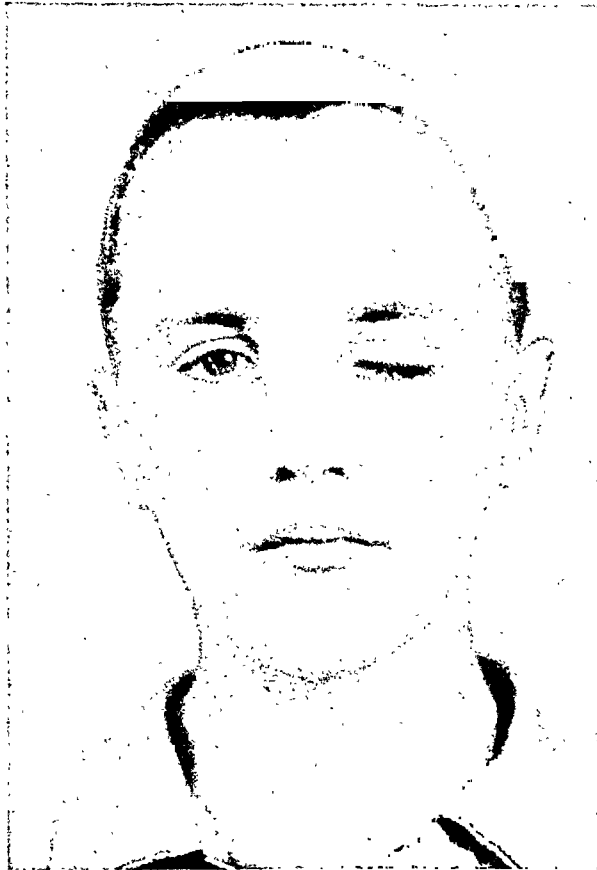


FIG. 10.



FIG. 11.

FIGS. 10 AND 11. Case of middle meningeal hemorrhage with left oculomotor palsy. As shown in Figure 11, patient still had a dilated pupil on the left side, two and a half months after operation. This boy had bloody spinal fluid with a pressure of 600 mm. of water. He was extremely ill and would have died within a few hours. The presence of grossly bloody spinal fluid should not be a factor in excluding middle meningeal hemorrhage of benign proportions as proven in this case.

lack of blood supply, the arachnoid does not help in any way.

The thought recently expounded by Gardner and others concerning the origin and formation of large cystic contents in chronic subdural hematoma is interesting and worthwhile. It is suggested that there is transference of spinal fluid and tissue fluid into the blood clot by osmosis and diffusion, thus accounting for the progressive enlargement of the subdural pathology. But it is rather difficult to explain why this same procedure does not reobtain following evacuation of such a subdural cyst through a small opening with no effort being made at removal of the wall of the cyst. It is reasonable to assume that soon after

as previously present. Of course, it is assumed that some postoperative bleeding obtains in the cyst cavity. Theoretically such a patient should return for further operative work in a short time. Some of our own cases have gone for longer than three years without any return of symptoms. What happens when the cyst wall is ruptured and the contents evacuated so that there is no return of cystic accumulation, is still a mystery.

The treatment is always surgical. It is preferable to trephine both sides of the skull even if the first opening uncovers the pathology. A single trephine opening has been found sufficient to drain the cystic contents and cure the patient. This was

done in four cases with excellent results. Subtemporal decompression on the side of the lesion was used in the remaining



FIG. 12. Chronic subdural hematoma associated with left third nerve paralysis. Complete return of extraocular movements obtained in eight weeks. The clot was found on the side of the paralyzed eye. In all cases of chronic subdural hematoma bilateral exploratory operation is in order.

cases. In this group no osteoplastic flap was performed for the care of the disease process. We usually leave a rubber drain in the subdural space which is removed in the next two days. If one treats this condition by a single trephine opening, it is advisable to insure complete evacuation of the cystic contents by postural drainage and washing out the subdural space with saline at the time of operation.

#### ACUTE SUBDURAL HEMORRHAGE

Acute subdural hemorrhage may be brought about by pial tears, contusion and laceration of nervous tissue. In some cases it was found to be sufficiently extensive to cover the hemispheric surfaces on both sides. In others it was more localized in its distribution and was frequently found along the region of the sylvian fissure of the brain. There is undoubtedly a good reason for such an occurrence, in that the frontotemporal region of the hemisphere is encased rather snugly in the cranial cavity with several sharp boundaries of bone extending into concavities of the brain. This is particularly true of the posterior boundary of the lesser wing of the sphenoid and its extension along

the parietal bone. This bony ridge can easily cause laceration and contusion of the frontotemporal junction of the hemisphere when the brain and the bone "crowd" each other in contrecoup lesions. In eleven cases where operation disclosed the presence of subdural clots, indications for operation were quite definite and neurological findings of positive localization were present in all. There was Jacksonian epilepsy in two. Lucid interval was present in two cases. Inequality of pupils was present in five cases. Dilated pupil on the side of the lesion with paralysis or paresis of the opposite half of the body was present in five cases. Continued unconsciousness and disorientation occurred among four.

There is a pronounced difference between cases of acute subdural hemorrhage and extradural hemorrhage as concerns the general appearance of the patient. The former look much sicker, with increased temperature and definitely increased respirations; this is particularly true in the earlier stages of the condition. Of the eleven patients five died. In this group of cases, we have not included those with very small subdural clots, as frequently seen with compound fractures and depressed fractures; these do very nicely.

Cases of subdural hemorrhage constitute the more chronic types of head injury, in that if they survive the condition they remain disabled and are confined to a hospital as long as three to five months. It is interesting to note that a number of these after long stay in the hospital because of marked disorientation, in due time recover rather completely their mental function; a majority, however, have marked personality changes.

Indications for operation in this group have been the progressive character of physical findings. The appearance of a paresis a day or two after the accident, Jacksonian convulsions of increasing severity and not treatable by lumbar puncture, the presence of a dilated pupil, long periods of drowsiness and disorientation tending to

become more severe, have been some of the factors favoring intervention.

The operation of choice has been subtemporal decompression. A good sized opening is made for decompressive purposes. The use of a brain spatula of appropriate size is of great help to milk the surface of the brain and to rid it of clots. Unless great care is taken in the use of the spatula it may cause much damage to the surface of the brain.

#### SUBDURAL COLLECTION OF SPINAL FLUID

In some cases the most important pathologic finding at operation was the presence of a large amount of spinal fluid in the subdural space. Whether this fluid, which may be trapped in the subdural space, actually causes sufficient pressure to bring about the clinical findings, is at times questionable. In a few instances such a cause and effect relationship may be satisfactorily proved by excellent postoperative recovery; in others, the operative intervention and evacuation of the subdural collection of fluid seem to have little or no effect on the course of the clinical manifestations. That there may be associated brain damage cannot be denied, for in a great many examples of head injury a combination of several pathologic entities may obtain at the same time. Small amounts of subdural fluid found at operation are not classified under this heading. Here, an ounce or more has been obtained in all of the thirteen cases classified under this category. Indications for operation were evident in all the cases. There was a lucid interval in two followed by progressive drowsiness and disorientation. Drowsiness and marked disorientation were present in four cases. Jacksonian convulsions were present in two. Third nerve paralysis was present in one. Hemiparesis was present in four and inequality of pupils was seen in five patients.

In two patients the results were miraculous. Consciousness was recovered soon after operation. There were six deaths. Such high mortality emphasizes the correctness of the assumption that undoubt-

edly most of these patients have associated damage to the brain. For instance, two autopsy cases in this group showed petechial hemorrhages throughout the nervous system.

We strongly suspect that hydroma of the brain as described by Dandy is undoubtedly the same as collection of subdural spinal fluid in the majority. External hydrocephalus associated with tears in the arachnoid membrane can allow accumulation of spinal fluid in the subdural space, thus bringing about this condition. It is possible that once this situation exists a vicious circle may obtain. With accumulation of subdural fluid sufficient to cause pressure on the brain, more fluid may be pressed out of the brain and its cavities to add to the size of the subdural collection.

#### EDEMA OF THE BRAIN, CONTUSION OF THE BRAIN SURFACE, SUBARACHNOID HEMORRHAGE

In fifteen patients, the pathologic findings at operation were those of suffused brain surface with marked edema, and in some cases with subarachnoid hemorrhage.

The indications for operation were lucid interval in two, dilated pupil in five, hemiplegia and hemiparesis in seven, generalized convulsions in one, and Jacksonian convulsions in two cases. The greatest majority of these patients were operated on soon after entrance into the hospital, certainly within the first twenty-four hours. They were all very ill from the beginning. There were eight deaths and in the greatest number the operation was resorted to with a meager hope that a condition of benign proportions might be uncovered. These were truly undertaken for the purpose of exploration.

#### COMMENT ON OPERATED CASES

On glancing over the indications for operation in cases of extradural hemorrhage, acute subdural hemorrhage, subdural collection of spinal fluid, marked edema of the brain and subarachnoid

hemorrhage it is apparent that a great many had identical signs and symptoms. For instance, lucid interval was seen not only in cases of extradural hemorrhage but also among cases with different pathology. Paralysis or paresis of one-half of the body associated with dilated pupil on the opposite side was seen frequently in cases of acute subdural hemorrhage, edema and contusion of the brain and subarachnoid hemorrhage. It is therefore evident that a great many patients were operated on because of a combination of certain signs and symptoms with the hope that the uncovered pathology would be of benign proportions. I feel that intracranial exploration in cases with definite findings is justified. The results will not all be satisfactory, but were one to follow a more conservative course I am sure one would allow the exitus of many a patient with an operable condition of the intracranial contents.

#### SUMMARY

1. In the majority of cases of middle meningeal hemorrhage there are neurologic signs implicating the cortex on the effected side. Widely dilated pupil on the same side is seen frequently, although one case in this series had dilated pupil on the opposite side. Pupils equal in size do occur; this was true in two cases in this series.

2. Bloody spinal fluid of varying concentration does not rule out middle meningeal hemorrhage. In this series all punctured cases had bloody spinal fluid. To assume that the condition is one of subarachnoid hemorrhage because of the bloody spinal fluid is a grave mistake in these cases.

3. Lucid interval may be absent in middle meningeal hemorrhage. This was true in more than half of the cases in this series. Lucid interval may be wiped out because of (1) very rapid hemorrhage and (2) associated severe damage of the brain.

4. Lucid interval was seen not only in cases of middle meningeal hemorrhage but also in those with acute subdural hemor-

rhage, subdural collection of spinal fluid and edema of the brain.

5. Chronic subdural hematoma usually follows slight injury to the head, but in this series its association with severe brain injury and fracture of the skull is brought out. Seven cases had associated fracture of the skull.

6. The association of chronic subdural hematoma and relatively severe brain injury should be suspected in patients who remain unconscious, drowsy or disoriented for several weeks. Particularly if the spinal fluid pressure is high, an exploratory operation is justifiable.

7. When the question of cranial exploration arises, cases of head injury should be treated individually and if certain signs obtain operative intervention should be effected. In the presence of the proper signs exploration is justifiable even though results may not be favorable. In this clinic we are particularly impressed by a combination of all or some of the following signs as indication for exploration:

- A. Dulling of the conscious state leading to unconsciousness or progressive deepening of an unconscious state already present.
- B. Presence and progression of localizing signs rather than neurologic signs implicating the entire nervous system.
- C. Increase in spinal fluid pressure.
- D. Low pulse rate (in some cases).

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# FRACTURES OF SPINAL COLUMN

## A SIMPLE METHOD OF TRANSPORTATION

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THE irreparable damage that may result from the improper transportation of a patient with a fracture or

1. Turn the injured person so that he lies face downward.
2. Place a pillow, folded blanket, coat



FIG. 1. A, treatment at seat of injury. Position of patient. B, use of automobile seats for hyperextension of spine.



FIG. 2. A, method of raising injured person. Note position of blankets and pillows. B, method of transportation on a stretcher with blanket under the head and neck and another blanket under the pelvis to hyperextend the spine.

dislocation of the spine merits reporting a simple procedure for transporting these patients. This method also serves as an effective aid in reduction of these injuries.

### TREATMENT AT THE SEAT OF INJURY

The public and men employed in industries should utilize the following method in handling a person who has sustained an injury to the back and who cannot move because of pain or paralysis of the legs or arms.

or the seat of an automobile under the head and shoulders and another under the thighs to hyperextend the spine. (Fig. 1.)

### METHOD OF TRANSPORTATION

1. One assistant stands between the separated thighs facing the head of the injured person, and encircles his hands and forearms about the patient's thighs close to the pelvis.

2. The second assistant, facing the first, places his hands under the arm pits of the



patient and supports the patient's extended head against his body.

3. Simultaneously, both assistants gently raise the injured person, and the weight of the torso hyperextends the spine. (Fig. 2.)

The first assistant, who is holding the injured person's thighs, guides the second assistant, who walks backward or sideways as he is directed.

If the patient is to be transported with the aid of a stretcher, he is raised by the method outlined above. Then a stretcher is

placed on the ground. The folded blankets, pillows, or clothes are placed on the stretcher in the respective positions where the head and shoulders and the thighs are to rest. Injuries to the spine in the region of the neck necessitate placing the blankets under the extended head. The patient is gently lowered on to the stretcher. The stretcher is then raised and placed in the ambulance. Hyperextension of the spinal column is thus maintained during transportation. (Fig. 2.)



LYMPHOSARCOMA is not infrequent in the neck, and arises either in the lymphatic glands or else in the tonsil. It may be distinguished sometimes from other malignant tumours by its very rapid growth and spread, its comparative softness, its occurrence in younger patients, and the fact that it rapidly involves many different groups of glands of the neck.

From—"The Science and Practice of Surgery" by W. H. C. Romanis and Philip H. Mitchiner, 5th Ed. (Lea & Febiger).

# THE MANAGEMENT OF THE HERNIAL SAC\*

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EMBRYOLOGICALLY, the testicle, in its migration from the lumbar region into the scrotum, is preceded by a portion of the peritoneum, the processus vaginalis, which normally becomes obliterated shortly after birth. Where obliteration of the funicular process is wholly or partially incomplete, various types of inguinal hernia may develop. It can be readily understood that a persistent peritoneal sac is a potential factor in the etiology of oblique inguinal hernia. Therefore a cure for oblique inguinal hernia must concern itself primarily with the removal of the entire sac and redundant peritoneum, rather than with extensive repair of the inguinal canal.

Direct hernia, on the other hand, has no preëxisting path and is usually the result of weakness of the abdominal wall. Here redundancy of the peritoneum is not an important factor. Direct hernia is rarely observed in children and vigorous adults. It occurs most frequently in the later decades of life.

The reasons given for recurrences following the operation for inguinal hernia are extremely varied, but it is generally agreed that failure to remove the entire sac is the most common factor. Let us consider the causes of failure to remove the entire sac. Multiple sacs are the cause of recurrence more frequently than is generally supposed. In some instances an entire hernial sac may be overlooked, as in double, saddlebag or pantaloon hernia. In direct hernia, an indirect sac, which is nearly always present and should be removed, may be overlooked; and in oblique hernia, a direct sac, which may be present at times, is neglected. Both oblique and direct hernias may have bilocular sacs and unless these are found and removed, the hernia is bound to recur.

The appearance of a femoral hernia has not infrequently been observed following an operation for oblique inguinal hernia. It has been assumed in these cases that suturing the conjoined tendon to the shelving portion of the inguinal ligament has been the fault. The elevation of the inguinal ligament by this procedure in cases where relaxation of this structure is already present may have a tendency to increase the patency of the femoral canal. However, in a great number of instances, the femoral sac or peritoneal dimple probably existed at the time of the operation for the inguinal hernia, but was overlooked.

The bulge or weakness in the inguinal region which may be noted in the patient soon after operation, when he assumes the erect posture, is too often attributed to a faulty suture. More than likely an overlooked peritoneal diverticulum, funicular process, or relaxed peritoneal lining is at fault.

LaRôque states that recurrent hernia represents the incompletely removed original hernial sac or the development of an incisional rupture following breakage of suture or tissue by coughing, vomiting, or wound infection. He classifies recurrent hernias in three types:

1. Postoperative incisional ruptures following any type of abdominal incision.
2. Those in which the sac is incompletely removed.
3. Those recurrences at the lower angle of the canal having the appearance of a direct hernia.

1. Postoperative incisional hernia, whether a complication of hernioplasty or any other abdominal procedure, will be considered here only briefly. The most common factors causing its appearance are faulty suturing of the abdominal layers,

\* From the surgical service of the Jewish Hospital of Brooklyn, New York.

wound infection, weak and flabby musculature of the aged and infirm, and too sudden an increase in abdominal tension. It is with

They really indicate failure in removing the relaxed and redundant peritoneum over the urinary bladder at the time of the

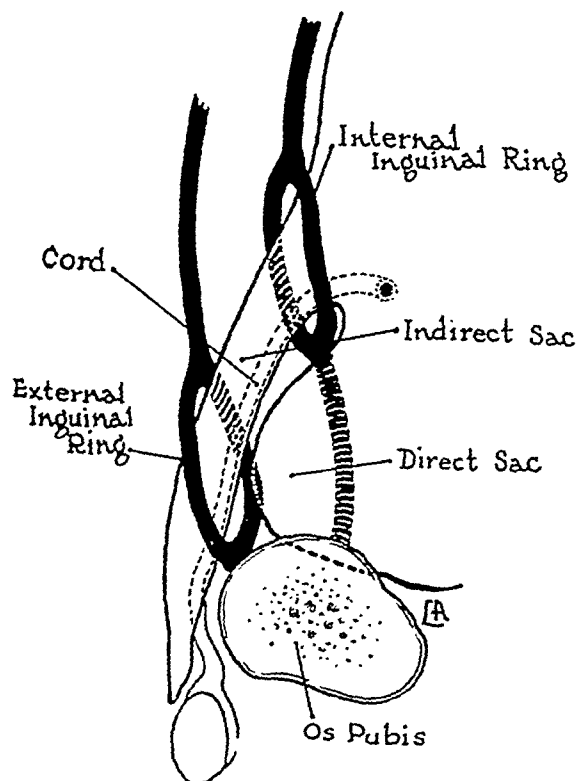


FIG. 1. Outline denoting the relationship between the internal and external rings of the inguinal canal and the direct and indirect hernial sacs.

the two latter types that we are especially concerned.

2. Failure to remove the entire hernial sac will result in a recurrence soon after operation. This may occur through careless or incomplete dissection of the oblique sac or failure to recognize the true neck of the sac. The latter condition was seen in an individual who presented a moderate sized tubular-shaped hernial sac partially closed by a small fibrotic diaphragm about one-half inch distal to the internal ring. During the operation the sac was drawn down from below the internal ring, thus leaving a funnel-shaped process or a dimple which formed the nucleus for a bulging at a later date.

3. Those so-called recurrences at the lower angle of the canal, having the appearance of a direct hernia, are not recurrences.

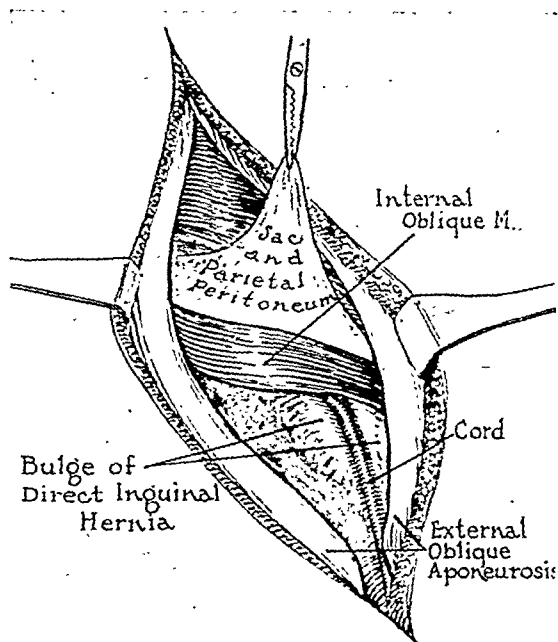


FIG. 2. The fibers of the internal oblique and the transversalis separated and the parietal peritoneum grasped above the internal ring. The bulging in Hesselbach's triangle shown.

operation for the original hernia. To obviate this difficulty and also to allow the complete removal of the sac and the redundant peritoneum, LaRoque devised his intra-abdominal operation for oblique and direct inguinal hernia. Further modifications of this principle were adopted by Banerjee and Easton.

In 1919, LaRoque described his method of attacking the problem of complete excision of the hernial sac from within the abdominal cavity. He claimed the following advantages for his procedure:

- (a) High removal of the sac.
- (b) Minimum of trauma to the fibers and the fascia of the cremasteric, internal oblique and the other muscles which may be utilized in wound closure.
- (c) Prevention of injury to the vessels of the cord, the vas deferens, and the urinary bladder.
- (d) Removal of redundant peritoneum.

Banerjee advocates the opening of the abdomen through a median subumbilical incision for the radical cure of hernia in

through a curved hockey stick incision, seems unnecessarily complicated.

The following operation is described in

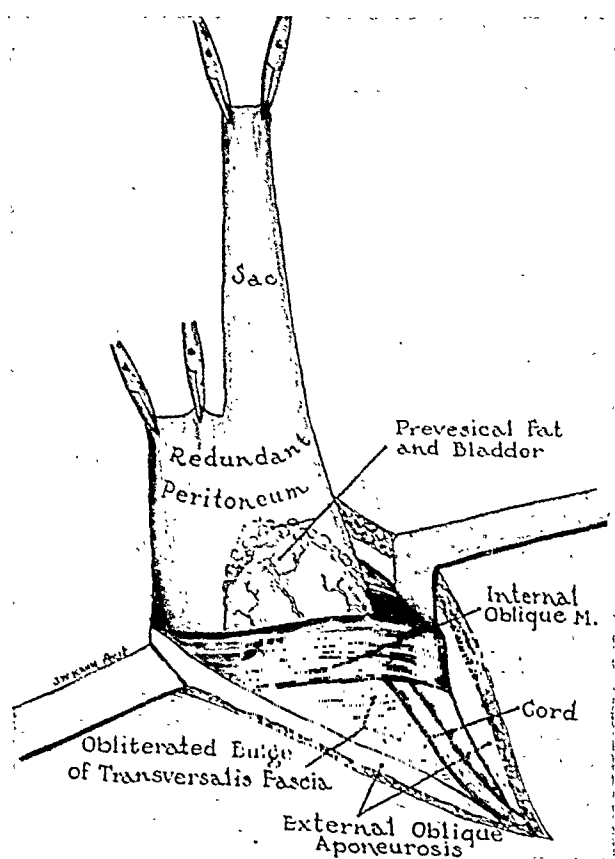


FIG. 3. The entire sac and redundant peritoneum have been withdrawn from the inguinal region. The bladder has not been separated from its attachment to the peritoneum.

adults. He closes the hernial opening by plicating the peritoneum about the orifice and then covering this fold of the redundant layer. By this method he not only closes the entrance to the sac, which he leaves in situ, but also irons out the dimple over the femoral ring. He states that it avoids interference with the circulation of the muscles and fascia of the inguinal region, which he believes is of prime importance in the prevention of recurrences. In celiotomy in which the coexistent hernia might be of only secondary importance, this method could be a valuable and time-saving procedure.

Easton's operation, which combines the external approach to the sac with Banerjee's treatment of the internal orifice, by infolding of the redundant peritoneum

DIAGRAM SHOWING MANAGEMENT OF INDIRECT, AND DIRECT SACS AND REDUNDANT PERITONEUM

FIG. I

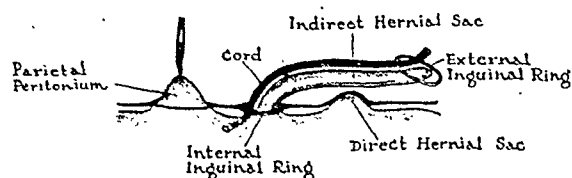


FIG. II

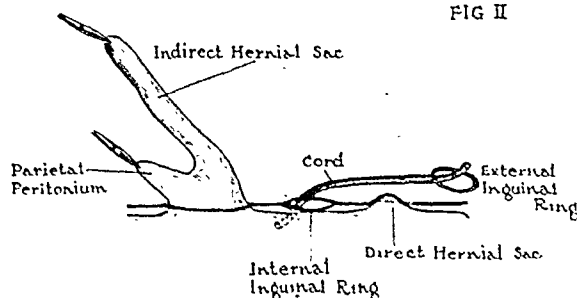


FIG. III

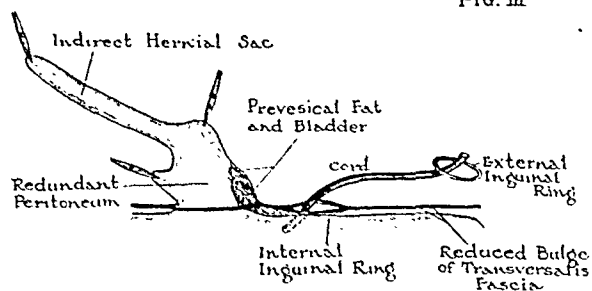


FIG. 4. Sketches I, II and III, indicating modus operandi.

the hope that it may offer more of the advantages and less of the drawbacks experienced with other methods. It is particularly efficacious in those patients with relaxed, flabby abdominal walls, in direct hernias, or in combined direct and indirect sacs.

The incision is the usual one from the pubic spine, 1 inch above and almost parallel to Poupart's ligament, to about 1 inch above the internal abdominal ring. The fascia of the external oblique muscle is split in the usual manner, namely in the direction of its fibers through the external ring, allowing a wide lower flap. The arched fibers of the internal oblique and the

transversalis muscles are separated by the insertion of a blunt pointed scissors through the fibers about 1 inch above the curving margin and at a higher level than the internal ring, almost in the same manner as one would approach the peritoneum in a McBurney incision.

The writer grasps the relaxed peritoneum with forceps or a hemostat in a line above the internal ring thus differing from the LaRoque technique, in which the peritoneal cavity is opened at once. (Fig. 1.) With the finger insinuated along the fold thus formed, the synechiae between the peritoneum and fascia are bluntly swept away. As the relaxed peritoneum is brought up through the wound, another hold is taken closer to its exit through the internal ring. The neck of the sac now appears. (Fig. 2.) This is grasped. The blunt handle of the scalpel is directed along the sac through the ring, releasing the sac still further. The operator now finds the plane of cleavage which permits the sac to escape easily from its attachments to the fascial tube, the vas deferens, and the spermatic plexus. With the entire sac in hand, the vas is easily swept away from the posterior wall into the retroperitoneal space without damage to its accompanying vascular structures. Further traction brings into view the yellow vascular perivesical fat and the urinary bladder. (Fig. 3.) This is brushed away from the parietal peritoneum. The sac and the redundant peritoneum are now entirely delivered into the wound and excised. The relaxation in the region of Hesselbach's triangle has disappeared. The rent in the peritoneum is closed with a running suture of catgut which also takes in a few bites of the transversalis fascia for fixation. A few plain sutures approximate the separated fibers of the internal oblique muscle. As the peritoneum is not opened until the sac is delivered into the wound, there is little danger of evisceration. The careful stripping of the peritoneum up to and beyond the deep epigastric vessels probably results in the more frequent appearance of the

bladder into the wound. In large hernias in elderly or flabby individuals, the bladder is frequently drawn into the hernial wound. By this method the relaxed and redundant peritoneum can be completely removed, thus preventing recurrence. This is the important part of the procedure to obtain the desired result, a cure of the inguinal hernia.

The repair of the inguinal floor may take whatever form is appropriate to the individual case. The writer more commonly uses the repair method of Willys-Andrews or some slight modification of it. The cord is transplanted beneath the skin within its undisturbed fascial tube and above the external oblique. This permits a more perfect closure of the two aponeurotic flaps of the external oblique and almost complete obliteration of the external ring. The fascial tube prevents adhesion of the vas to the scar.

Forty-one patients were thus treated for inguinal hernia. Twenty cases could not be reached for follow-up. The results in the remaining twenty-one cases, all male, are shown in Table I.

TABLE I

Hospital No.	Age	Hernia	Type	Pro-cedure	Result	Years
147630	23	left	direct	author's	cured	5
147936	21	left	indirect	author's	cured	5
149317	48	right	pantaloon	author's	cured	5
		left	direct	author's	recurrence	1 1/2
153092	65	right	indirect	author's	cured	5
153225	36	left	indirect	author's	cured	5
154237	51	right	pantaloon	author's	cured	5
158167	60	right	pantaloon	author's	cured	4
		left	pantaloon	author's	cured	4
161203	55	right	indirect	Bassini	recurrence	1
		left	pantaloon	author's	cured	4
165512	62	left	indirect	author's	cured	4
168102	46	right	pantaloon	author's	cured	3
		left	indirect	Bassini	recurrence	2 1/2
177873	65	left	direct, indirect & femoral	author's	cured	2
1-8655	37	right	pantaloon	author's	cured	2
		left	pantaloon	author's	cured	2
181289	37	right	indirect	author's	cured	2
182386	45	right	indirect	author's	cured	2
182662	25	right	pantaloon	author's	cured	2
189932	34	right	direct	author's	cured	1
189377	27	right	pantaloon	author's	cured	1
189412	48	left	direct & femoral	author's	cured	1
191671	47	right	pantaloon	author's	cured	1
192701	36	left	pantaloon	author's	cured	1
194339	47	left	direct	author's	cured	1

Twenty-six operations were performed in this group as follows:

Indirect.....	8
Direct.....	3
Pantaloon (combined direct and indirect sacs).....	13
Recurrent direct.....	2
Femoral.....	2

Femoral hernia appeared twice as a complication of the inguinal variety and was therefore repaired through the inguinal incision. Acute strangulation and an undescended testicle appeared once in this series.

Five patients were subjected to bilateral hernioplasties and in this group there were three recurrences. In one instance the recurrence followed the author's technique and in two cases the classical Bassini procedure. Apparently this would indicate that the simultaneous surgical repair of bilateral hernias tends to increase the incidence of recurrence.

*Postoperative Course.* Temperature reaction ranged from 99 to 102.8 degrees. Temperatures over 100 degrees were seldom seen after the third day. Hospital stay averaged fifteen days; for bilateral hernias, seventeen days, and for unilateral hernias, twelve days. One patient with a recurrent direct hernia on whom an extensive ilio-tibial fascial transplant was performed, stayed twenty-three days.

#### COMMENT

Sliding and other anomalous forms of hernia may be readily recognized. The incarcerated and strangulated varieties may be inspected from within the abdomi-

nal cavity and appropriate measures applied. Any form of repair may be utilized. Occasionally one has some technical difficulties with a very thin peritoneum because of tearing. However, with care this too can be handled with the usual routine procedure.

This technique is especially adapted to recurrent cases. In such instances the redundant peritoneum or sac may be removed without disrupting the entire sutured canal. There is little or no trauma to the cord and its vascular components. The infundibuliform fascial tube is left intact about the cord. The bladder may be easily recognized and steps taken to prevent accidental injury.

#### SUMMARY

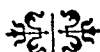
A method for the management of the hernial sac and redundant peritoneum is described. It presents the following advantages:

1. High removal of the sac and redundant peritoneum.
2. Inspection of the abdominal cavity if necessary.
3. Exposure without trauma to the vas deferens and the bladder.
4. Adequate repair of the inguinal canal.

I am indebted to Dr. Jacob W. Kahn for the accompanying illustrations.

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# RECONSTRUCTION OF INTERNAL RING WITH ATTACHED FLAPS OF APONEUROTIC FASCIA IN INDIRECT INGUINAL HERNIA

## PRELIMINARY NOTE

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THE mechanism of the production and development of indirect inguinal hernia is still an unsolved problem, while first made of operations which "have for a long time been abandoned, viz.:

"1. Castration.

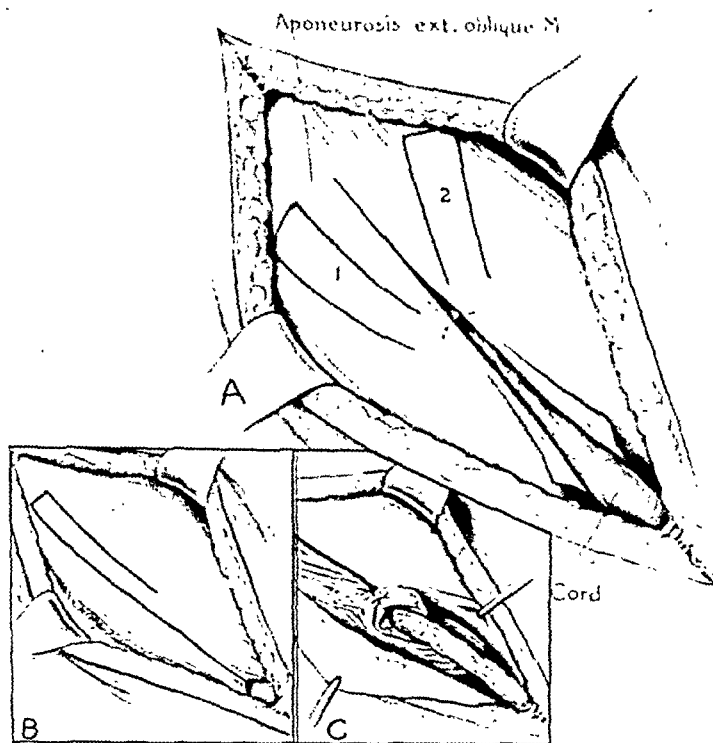


FIG. 1. A, wide exposure of aponeurosis of ext. oblique. Pedicled flaps outlined. Aponeurosis centrally divided. B, single flap outlined when flap proves impracticable. C, disposition of single flap around internal ring.

the technique of hernioplasty has been so well covered as to leave apparently little room for improvement.

Hernia makes an interesting chapter in the history of progressive surgery. Joseph Pancoast,<sup>1</sup> in his "Treatise of Operative Surgery," published in 1846, makes several interesting observations in his chapter on the Radical Cure of Hernia: Mention is

"2. Cauterization upon the surface of the skin, or upon the neck of the sac after the skin has been laid open so as to expose the cavity.

"3. Ligation of the neck of sac with a gold thread, known as the golden stitch.

"4. The Royal Stitch, which consisted in sewing up the neck of the sac, and excising

all the body of the sac below the line of suture.

by "injection . . . as employed by the author."

"5. The Spanish process, in which the

Bassini,<sup>2</sup> in 1883, attempted the radical

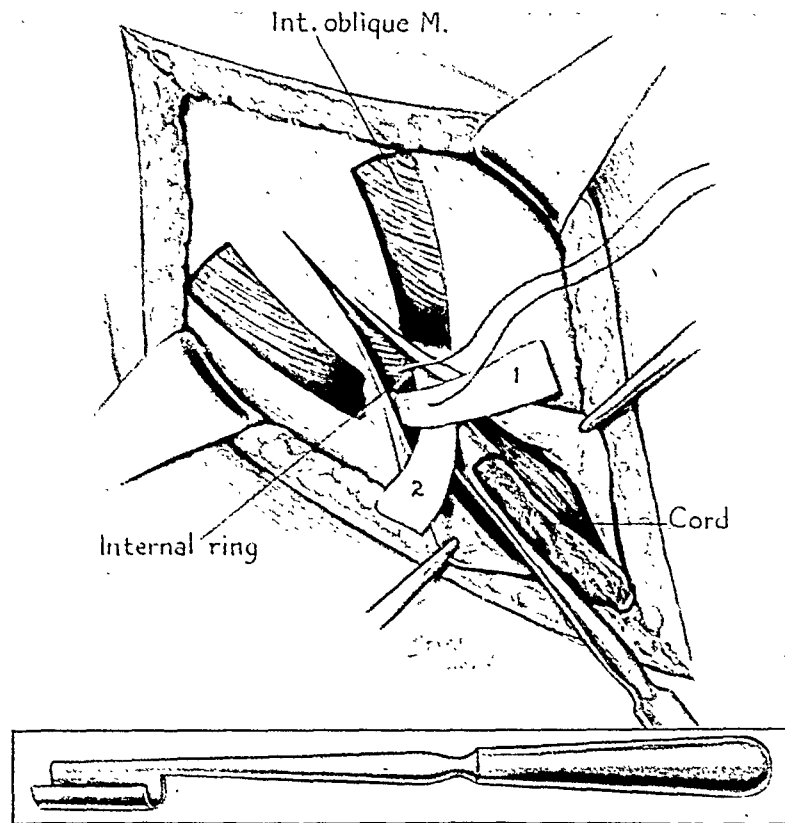


FIG. 2. Pedicled flaps inverted, crossed over each other and tied, with cord retractor in position protecting cord. Insert shows cord retractor.

sac was laid open for the purpose of pushing the testicle into the cavity of the abdomen, and closing the neck with the golden stitch.

"6. Reduction of the hernial sac entire after having previously dissected it up from its attachments."

A method of "Acupuncturation" is then described: "It consists in making from the surface of the skin one or two rows of punctures with a common acupuncture or large sewing needle across the neck of the sac immediately below the orifice of the external ring." This, it appears, was intended to produce an "irritation" and a final "obliteration" of the sac. Very soon after it was found that there was a "more positive means of exciting inflammation by the instillation of a few drops of some highly stimulating fluid into the cavity of the sac." Then follows a lengthy description of the process of curing inguinal hernia

cure of indirect inguinal hernia by using the stump of the sac as a stopper to the internal ring. One year later he devised the classic operation which bears his name and which is most commonly performed today, with or without various modifications, as the operation of choice in this type of hernia. In 1890, he published his results in 262 hernias operated upon by him, in which the present Bassini operation was employed.

Watson<sup>3</sup> describes the obliquity of the inguinal canal as being a natural obstacle to hernia, because an increase in intra-abdominal tension forces the inguinal walls more firmly together. It appears that Bassini's original thought was primarily to "make it unnecessary for the patient to wear a truss after operation." Obviously what he had in mind was that the mechanical effect of wearing a truss could more



permanently be reproduced by his operation of reconstructing the canal, and making a new bed for the cord by suturing the

The physiologic adaptability of fresh sutures of fascia lata in hernia repair has been definitely established. It has also been

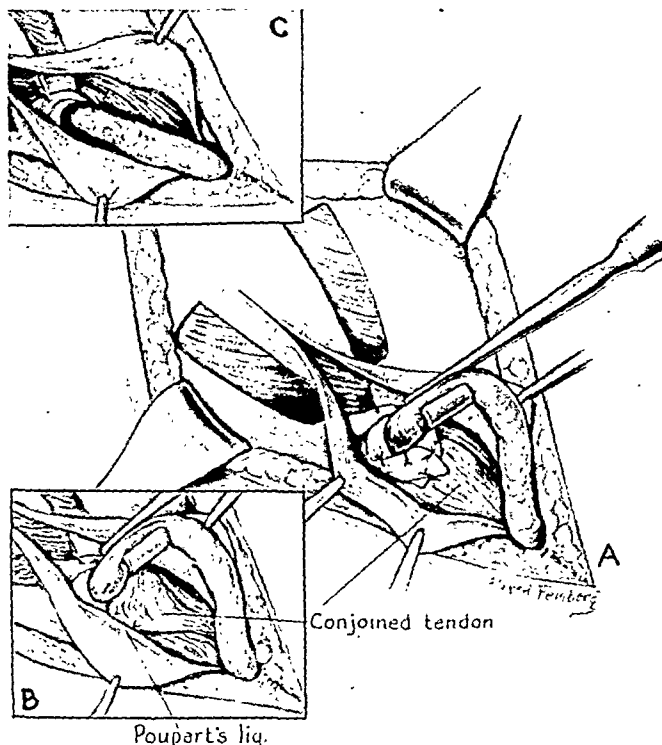


FIG. 3. A, pedicled flaps sutured around the margin of ring, overlapping at four points of circumference. B, upper fibers of conjoint tendon sutured to Poupart's ligament. C, cord placed following reconstruction of ring.

conjoined tendon to the "posterior margin of Poupart's ligament."

I am inclined to discount the importance which has been given to the pathologic changes of direction of the canal, which apparently take place only in indirect inguinal hernia. Regardless of change of direction, or the thin and weakened structures which may constitute the immediate environs of an indirect inguinal hernia, it is inevitably through an imperfect internal ring that the sac and its contents must gain entrance to the canal. The recent revival of methods of injecting the rim of the ring for the purpose of constricting it by cicatrization, is an indication that the trend of thought is toward the basic importance which the ring plays in the etiology of this type of hernia, although the procedure itself, for obvious reasons, should be severely condemned.

shown that attached tissue transplants fare better, on the whole, than when they are detached.

With this in mind, the following operative procedure has been devised, and its practicability demonstrated on the cadaver:

Dissection exposes a wide expanse of the aponeurosis of the external oblique through an incision parallel to Poupart's ligament and approximately 3 cm. internal to it, extending from a point about 4 or 5 cm. below the anterior superior spine of the ilium down to about 2 cm. from the pubic spine. The dotted lines in Figure 1 indicate from which part of the aponeurosis the flaps may be secured. Insert B shows an alternative method of obtaining a single fascial flap and Insert C illustrates its final disposition. The tensile strength of flaps parallel or at right angle to the direction of

the aponeurotic fibers is approximately identical.

Exposure of the cord, isolation of the sac,

the upper fibers of the conjoined tendon sutured to the overshelving portion of Poupart's ligament may reinforce the

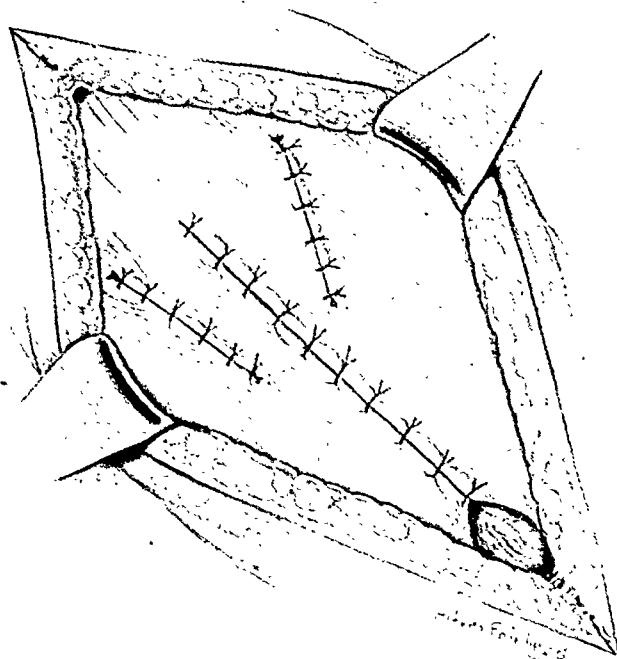


FIG. 4. Final repair of operative defects of aponeurosis of external oblique.

identification of contents and their reduction with high ligation of sac are carried out in the usual manner of the Bassini operation.

Figure 2 illustrates the pedicled formation of two aponeurotic flaps as to required length and width. This is the method of choice. The use of one long strip of fascia, as shown in Insert B of Figure 1, may be employed as an alternative method. The flaps are inverted and cross each other at the upper margin of the ring to which they are sutured before proceeding further. Insert c (Fig. 1) shows method of inverting the single flap.

The cord-shield and retractor which I have specially devised for this procedure, in position as illustrated, protects the cord in the process of suturing the flaps to the ring in the several positions around the cord.

The flaps are sutured to the lateral margins of the ring and overlap themselves at four points of the circumference. (Fig. 3.) Insert B illustrates the manner in which

lower portion of the ring without actually reconstructing the entire canal. Insert c shows the cord in final position. The aponeurotic repair is completed, as shown in Figure 4.

#### SUMMARY

1. The basic importance of the imperfect internal ring in the production of indirect inguinal hernia is stressed.
2. A brief history of methods of dealing with indirect inguinal hernia, leading to the present day conception of treatment of hernia by injection, is given.
3. A method of reconstructing the internal ring with attached flaps of fascia from the aponeurosis of the external oblique is shown to be mechanically practical.

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# THE SQUARE KNOT: RATIONALE OF TECHNIQUE\*

## A ONE-HANDED "THUMB-ROLL" MANEUVER

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### INTRODUCTION

THE square knot consists essentially of loop within a loop. (Fig. 1.) Concerning its production, Livingston<sup>1</sup> in a masterly paper, demonstrated that it must depend, fundamentally and physiologically, on but two types of maneuvers, either:

(a) "the maneuver of ambidexterity," in which identical movements of first one, then the other hand, produce the square knot;

(b) "the maneuver of bimotility," in which a square knot is obtained when the two component ties are made by opposite motions of the same hand.

Thus a criterion may be established, namely: that the value of a knot-tying technique should be measured by the relative movements of the hands and fingers, rather than the varied relations of the cords (which in the final analysis are dependent on the former).

In other words, that procedure is best which (a) entails the least movement of the fingers and hands; (b) obviates or reduces to a minimum cumbersome motions, as crossing of the hands, and especially supination, and extension of the fingers, the awkwardness of which has been amply demonstrated;<sup>1</sup> (c) insures control of the tying procedure during all stages of the maneuver; (d) avoids displacement of the first simple knot (Fig. 2), which would result in a loose and insecure tie; (e) is fastest.

If the needs of the surgeon be analyzed, it becomes apparent that no one procedure, be it bimanual, one-handed, or instrumental, offers itself as the ultimate in perfection for all occasions. For the usual

situation, the bimanual technique serves well. With respect to variations in this maneuver<sup>1-8</sup> discussion here is out of place, though the criteria presented above apply just as well; and the same general rules can be applied to the instrumental techniques<sup>1,9-14</sup> which are of distinct value when a "no-hand-touch" asepsis is required, etc. Also, with this in mind, it should be an easy task to ascertain the value of those methods primarily consisting of tricks<sup>15</sup> and flashy maneuvers with but little practical advantage.

The scope, then, of this paper lies with the technique of the one-handed knot, which has its chief value when one of the surgeon's hands is occupied with a long suture or needle-holder, a condition that not infrequently occurs.

I desire to present first the maneuver I employed—one as effective as it is simple—and then to compare it, in the light of the criteria presented above, with the one-handed procedures which have had the merit of publication.

### TECHNIQUE

*General Directions* (of value no matter what manual procedure is employed). Mention should be made of the fact that there is no so-called one-hand maneuver which utilizes one hand exclusively; the second is absolutely necessary in tightening the knot made by the one hand, if displacement of the first knot or a loose tie is to be avoided.

In the case of a ligature, the square knot should always be tied to effect the long axis of the knot (Fig. 1) in parallel relation to the sagittal plane of the surgeon's body; or the long axis of the wound to be sutured should be in relation to the frontal plane

\* From the Department of Surgery, Trinity Hospital, Brooklyn, New York, Dr. Julius B. Boehm, Director.

of the body. For this, the surgeon may find it necessary to twist his trunk slightly.<sup>1</sup> The value of this is that it obviates crossing of

clockwise direction, until a complete rotation has been effected.

4. Continuing to hold the short end

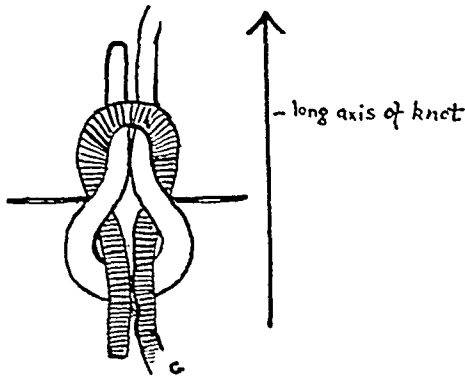


FIG. 1.

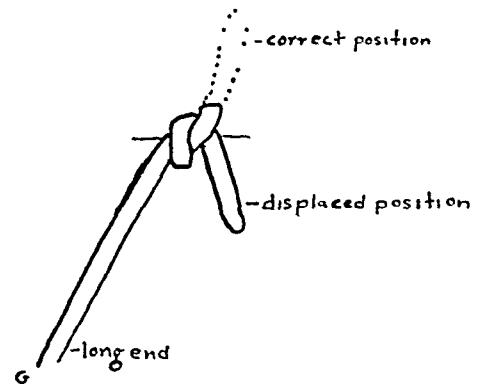


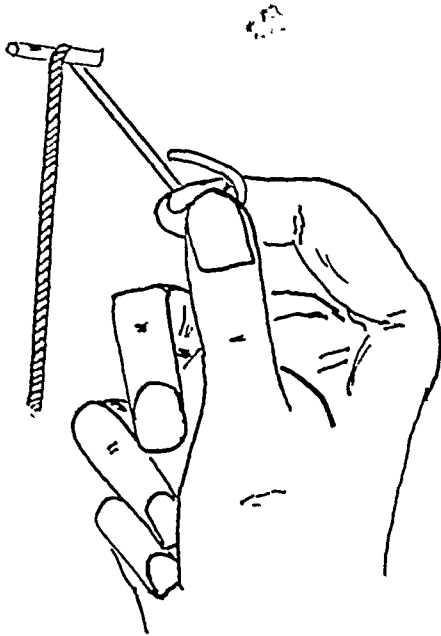
FIG. 2.

the hands when the knot is tied, the hands moving rather toward and away from the body.

*The One-Hand Thumb-Rolling Maneuver.* Only the thumb and index finger are employed.

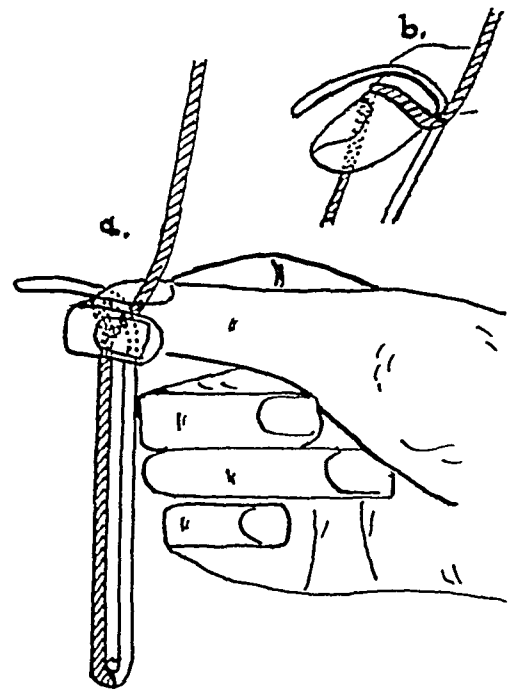
between the thumb and index finger, pull the right hand away from the body, and the left toward the body slightly. This completes the first tie, a simple knot. (Fig. 5a.)

5. Twirl the index finger, with the aid of the thumb, around the short end, reversing



Goldberger '37

FIG. 3.



Goldberger '37

FIG. 4. A, lateral view. B, looking from above on index finger. Thumb has been raised.

1. Grasp the short end with the thumb and index finger of the right hand. (Fig. 3.)

2. Bring the sides of the long and short ends together. (Fig. 4.)

3. Slide the thumb toward the tip of the index finger, and slide the index finger similarly, causing the short end to roll over and around the long end in a counter-

the direction of the free end. (Figs. 5b, c.) This serves to reverse the first maneuver.

6. Bring the sides together, as in step 2. (Fig. 6.)

7. Again, roll the short end counter-clockwise over and around the long end.

8. Tighten the second tie, pulling with

number of hand and finger movements necessary; the number of times the hand must be supinated and pronated; how

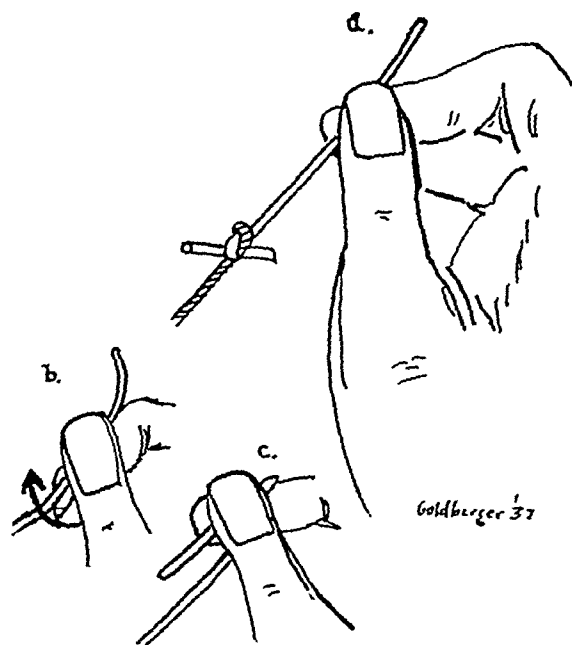


FIG. 5.

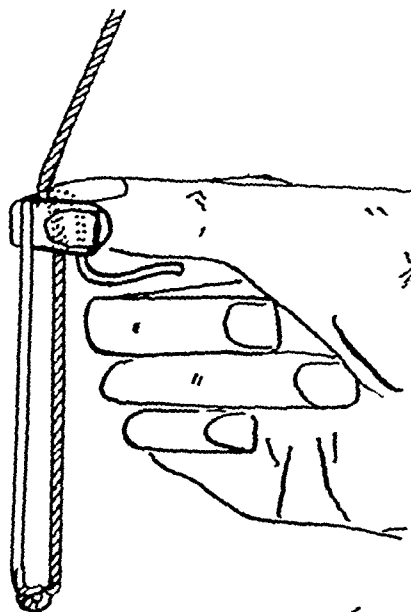


FIG. 6.

the right hand toward the body, and with the left, away. This completes the square knot.

#### DISCUSSION

As has been said before, the efficacy of a knot-tying technique can be judged by the

TABLE I  
ONE-HANDED KNOT-TYING MANEUVERS

Technique	No. Finger and Hand Movements	No. Times Supination and Pronation	No. Changes of Cord-Hand Relationship	Displacement of First Knot
Author's.....	8	0	1	no
Livingston <sup>1</sup> .....	8	3	1	no
Meynen <sup>16</sup> .....	8	3	1	no
Sullivan <sup>17</sup> .....	not a square knot but "surgical."			
Monks <sup>*18</sup> .....	10	3	3	yes
Richardson <sup>3</sup> .....	9	1	2	a badly tied knot
Kubo <sup>19</sup> .....	not a square knot, but "surgical."			

\* This technique necessitates crossing of the hands twice.

many times there are changes in the suture (or ligature) hand relationship, not related directly to the tie; the degree of control obtained; and the speed. (Table I.) With respect to speed, this is a factor so dependent on one's familiarity with the technique used that its inclusion as an index of comparison is not warranted.

The same standards were employed in calculating the number of finger and hand movements (or steps) etc. in the procedure described above, as for the others noted in Table I.

On the basis of the values obtained above, I can no more than conclude that the procedure I employ, compared to those I was able to find mention of, is the simplest. The effectiveness, of course, of any method which follows the general principles outlined above must be the same. That is to say, a square knot is a square knot whether it was tied in two or twenty seconds, or with one hand or four instruments.

#### SUMMARY

1. The general principles of tying the square knot have been enunciated.

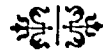
2. Indications for various techniques have been described.

3. A new and simple procedure for the so-called one-handed square knot has been presented.

4. Comparison has been made between this and what other methods had been found in the literature.

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# SIMPLIFICATION OF DATA ON THE SERIOUSLY SICK SURGICAL PATIENT

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COUNCIL BLUFFS, IOWA

THE seriously sick surgical patient presents many problems. Not one of the least of these is a satisfactory method of recording the ever changing clinical picture of the patient.

double line being drawn between days. Some of the columns are self explanatory. Under fluid intake are included the four possible routes. In many patients with a Levine tube with the Wangenstein suction attached there is never-

[illegible]

FIG. 1.

The following method has been incorporated on the surgical service at the Sisters Hospital in Hot Springs, South Dakota:

1. The temperature, pulse and respirations are recorded as usual on the standard sheet.
2. The standing orders are copied onto a separate sheet every twenty-four hours by the night shift. In this way each morning only the live orders are present on the sheet.
3. A third sheet has been originated. (Fig. 1.) All columns are filled in each twelve hours, a

theless some fluid retained orally. While most of these patients get fluid intravenously, columns are left for recording of the subcutaneous and proctoclysis fluids. As a rule 1000 c.c. of 5 per cent glucose in saline is given at the start of the day, the remaining fluid being 5 per cent glucose in distilled water. On long continued cases we prefer the intravenous cannula.

Under fluid output we usually attempt to have 1500 c.c. of urine daily. A space is left for emesis, its character and amount usually being recorded.

Under gas we have left space for the amounts of both rectal and duodenal gas. A Wangenstein apparatus is often attached to a rectal tube in cases with distention, particularly that of the lower bowel, in addition to the inlying duodenal tube with suction. B.M. can be recorded under the rectal gas column.

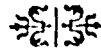
Urinalysis is routine every twelve hours in these cases. Sugar, albumin, acetone and hydrogen ion concentration are checked. We very rarely use insulin in our intravenous glucose solution but are on a constant watch for a spill in the urine which indicates its use.

Blood pressure has a column to itself. A check on this every six hours (two B.P. to the

column) warns us of early peripheral vascular or cardiac failure which is so important, particularly in ileus and respiratory complications.

Under Remarks is left a space wherein other essential data can be placed. These are chiefly laboratory data or unusual clinical facts noted by the nursing staff. Under Laboratory often comes total white counts, less often blood sugars and non-protein nitrogens.

The use of these three sheets in the manner mentioned has greatly simplified and clarified in our minds the care of the seriously sick surgical patient.



PATIENTS with enormous effusions [acute empyema thoracis] causing respiratory distress are best treated by aspiration. The amount of fluid withdrawn should be determined by the relief obtained.

From—"Pediatric Surgery" by Edward C. Brenner (Lea & Febiger).



# MONOETHANOLAMINE OLEATE\*

## A NEW CHEMICAL FOR THE OBLITERATION OF VARICOSE VEINS

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NEW YORK CITY

THE use of sodium morrhuate for the injection of varicose veins has been widely adopted because of its superiority over most of the other agents.

Its advantages were listed as follows:

1. It is practically painless.
2. There is diminished likelihood of slough when small amounts are infiltrated during an injection.
3. Its efficacy is at least comparable to the other agents in producing a firm thrombus.

However, there have been appearing in the literature repeated reports of allergic manifestations following the use of sodium morrhuate. These manifestations vary from mild erythema to severe generalized urticaria and even anaphylactic shock. There are probably many more of these cases that never reach the literature. The author has observed numerous such reactions to morrhuate, especially of the urticarial variety. Conversation with other physicians has revealed that these reactions are not uncommon.

Upon considering the composition of sodium morrhuate, the reason for this high incidence of allergic reaction becomes obvious. Its exact composition, even in the purified form, is unknown. It is virtually impossible to remove all the fish proteins which are present, in small amounts to be sure, but sufficient to cause hypersensitivity in allergic subjects.

Monoethanolamine oleate has been synthesized in the chemical laboratory and is of known composition. As the name implies, it is a soap of monoethanolamine and oleic acid. The structural formula is  $\text{CH}_3(\text{CH}_2)_7\text{CH}=\text{CH}(\text{CH}_2)_7\text{CO}-\text{NH}-\text{CH}_2(\text{CH}_2)\text{OH}$ . The compound is a yellow-

ish viscid liquid, soluble in water. Its viscosity in a 5 per cent solution is somewhat less than sodium morrhuate. Monoethanolamine oleate has been tested in the biologic laboratory. The minimum lethal dose intravenously in rabbits is 130 mg. per kilo, as compared to 100 to 125 mg. per kilo in sodium morrhuate.

In the chemical and biologic laboratory the compound was found to be satisfactory and at least as safe as the older solutions. There remained the proof of clinical trial.

Forty-three consecutive cases were injected with the solution. Of these fifteen were males and twenty-eight females. A total of 345 injections were given. The technique used was virtually the same as with sodium morrhuate. Single injections were given once a week and the amount of thrombosis noted the following week. The patients were questioned for any possible reactions. The initial injection was usually 1 to 2 c.c. The thrombosis was noted the following week and the amount of subsequent injection regulated as required by the individual patient and the size of the vein. No tourniquets were used except in cases where there was a failure of or insufficient thrombosis. For statistical purposes, the resulting thromboses were divided into the following classes:

Class 0: Failure of thrombosis.

Class 1: Thrombosis up to one-half inch.

Class 2: From one-half inch to 2 inches.

Class 3: Over 2 inches or with chemical phlebitis, but with no tendency to break down.

Class 4: Ascending chemical phlebitis.

Thromboses in Class 2 were considered optimum. While Classes 3 and 4 produced good end-results, we felt that they were

\* From the Out-Patient Department of Lincoln Hospital, New York City.

undesirable because discomfort often prevented the patient from doing his usual work, so that treatment could no longer be considered ambulatory.

The thromboses produced were as follows:

Unrecorded:	5 injections
Class 0:	11 injections
Class 1:	27 injections (Note: Most of these resulted from the small amount used in the initial injection.)
Class 2:	28½ injections
Class 3:	16 injections
Class 4:	2 injections

There were no sloughs in spite of the fact that on numerous occasions small amounts were infiltrated. There was no evidence of allergic reaction in any of the patients.

The volume of solution injected varied from 1 to 5 c.c., the usual amount required being from 2 to 3 c.c. Of the 345 injections, 287 were from 2 to 3 c.c., and 203 from 2.5 to 3 c.c.

At one time we ran short of the oleate, and substituted sodium morrhuate temporarily in many of the cases. Following the morrhuate injections there resulted two cases of urticaria. One patient refused further treatment. In the other case treatment was continued with the oleate, and the urticarial symptoms subsided. After two weeks a small amount of sodium morrhuate was again injected with return of the urticaria.

#### SUMMARY

A clinical trial of a new chemical, monoethanolamine oleate, was made on forty-three cases; a total of 345 injections were given. In every case a good thrombus could be produced either at first or subsequently on injection. There were no cases of slough or any evidence of allergic reaction.

#### CONCLUSION

Monoethanolamine oleate is a satisfactory substitute for sodium morrhuate. It is comparable to the morrhuate in its lack of pain, its efficacy in production of thrombosis and prevention of slough. It is superior to morrhuate because it is of known standard composition, it is more stable in solution, and has less tendency to produce allergic reactions.

The monoethanolamine oleate for this study was supplied through the courtesy of the Abbott Laboratories.

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# CASE REPORTS

## PERIRENAL TUMORS CAUSING RENAL DISTORTION

### REPORT OF A CASE OF PERIRENAL FIBROMA

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ANY retroperitoneal tumor in the vicinity of the renal fossa or ureter may cause sufficient distortion of the kidney or ureter to give rise to symptoms referable to the genitourinary tract. Distortion may be caused: (1) by direct pressure of the tumor upon the kidney or ureter; or (2) by retraction, especially in cases of enlarged retroperitoneal tuberculous lymph nodes resulting in (a) rotation of the kidney upon its vertical or horizontal axis, (b) compression or angulation of the renal pelvis, and (c) compression or dislocation of the ureter. In fact, Andrews,<sup>1</sup> reporting on twenty-eight cases of retroperitoneal sarcoma, noted six patients (21 per cent) complaining of increased urinary frequency, and one of dysuria and hematuria.

To enter into a detailed discussion of the entire subject of retroperitoneal tumors would lead one too far astray from the purpose of this communication. Suffice it to say, however, that such neoplasms are not rare. Gobell,<sup>4</sup> in 1901, collected 101 cases of retroperitoneal tumors, of which thirty-two were malignant, forty-three solid benign and twenty-six cystic benign. Andrews, in 1923, was able to collect 142 cases of primary retroperitoneal sarcoma including twenty-eight cases from the Mayo Clinic, while Magoun<sup>5</sup> reported seventy-three cases of general retroperitoneal tumors of all types from January 1907 to September 1919, collected from the records of the Mayo Clinic. Of this number fifty-three were operated on, disclosing

twenty-nine malignant tumors and eighteen benign. Six were undetermined.

Steele,<sup>8</sup> in 1900, collected sixty-one cases of retroperitoneal sarcomata, of which number forty-four cases were subjected to microscopic examination, disclosing eleven round-cell sarcomata, twelve spindle-cell, seven spindle and round-cell sarcomata, five lymphosarcomata, eight myxosarcomata and one endothelioma. Maclair<sup>6</sup> classified such tumors in the following groups: pure lipoma; pure fibroma; myxoma; chondroma; myoma; neuroma; sarcoma; lymphadenoma; and all varieties of cysts.

The sources of origin of retroperitoneal tumors are: (1) the retroperitoneal lymph nodes (64 per cent of Steele's series); (2) the connective tissue around the spine, the sheath of vessels, the iliac region, the pelvis and around the kidney; and (3) the endothelium of lymphatic radicles around the kidney. In Steele's series 36 per cent arose from connective tissue of the retroperitoneal spaces and the sheaths of the great vessels. This same author gave the site of origin of the tumor as the lumbar region in 57 per cent of the cases and the central portion of the abdomen about the attachment of the mesentery in 41 per cent of the cases. In the lateral tumors Steele found the right side was much more often affected than the left, and in most of these lateral tumors there was some involvement of the corresponding kidney. The tumor was either adherent to or surrounded the kidney.

The largest malignant tumor on record was a myxo-fibro-chondrosarcoma, weighing 34 pounds, reported by Bull.<sup>2</sup> Of the

tumor extending along the long axis of the abdomen and failing to exert dislocating action upon neighboring organs or severe



FIG. 1. Flat film showing the relationship between the tumor and the right kidney.

benign tumors the lipomata grow the largest. Most of the malignant tumors, when found at operation or at post-mortem, were large. Twenty-three of the twenty-eight tumors of the Mayo series reported by Andrews were in males. In only one case in this series were multiple tumors found. Unlike the findings in Steele's series, thirteen of the growths were found on the left side and nine on the right; three were in the pelvis; two were noted as being centrally located; and one extended across both sides of the abdomen.

**Symptoms.** Symptoms are naturally dependent upon the size of the tumor and its proximity to and involvement of neighboring structures, so that at times a tumor of relatively small size pressing upon nerve structures or upon a hollow viscus such as the ureter or intestine may give rise to more pronounced symptoms than a large soft



FIG. 2. Intravenous pyelogram showing the folding distortion of the right pelvis and the displacement of the upper portion of the right ureter.

pressure upon nerves or vascular structures. In practically all cases the onset of symptoms is usually insidious, with indefinite abdominal pain, occasionally colicky in character, and accompanied by nausea or vomiting and a certain amount of abdominal distention. Dull lumbar pain is present in cases in which the tumor causes a dislocation of the kidney. In the event the tumor leads to interference with the free drainage of urine from the infected kidney, the patient may experience an attack of renal colic. Renal pain may also result from pressure or traction upon the renal pedicle and its sympathetic nerve supply.

Ellis<sup>3</sup> reported a case of a tumor surrounding the left kidney in a boy of 7, which gave rise to occasional edema of the scrotum, left lung and left side of the face.

He attributed these symptoms to probable pressure of the tumor upon the sympathetic nerve system. Osler<sup>7</sup> reported a case

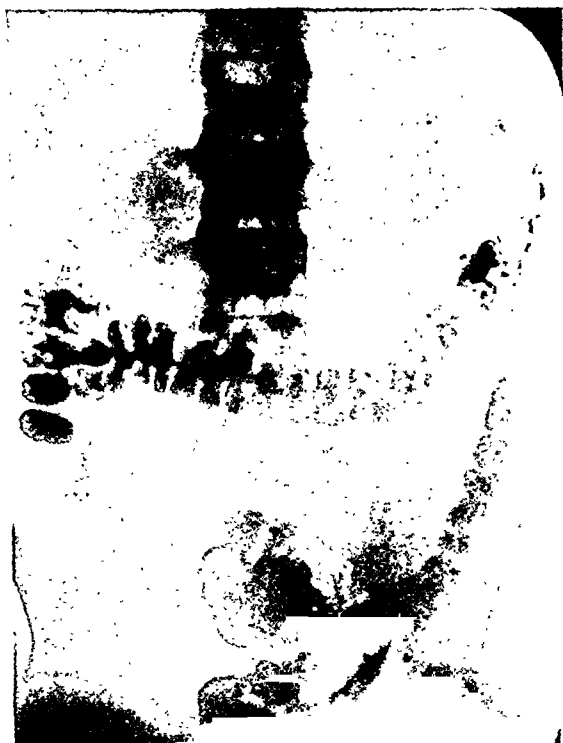


FIG. 3. Barium enema, showing the relationship of the tumor to the transverse colon.

presenting polyuria, possibly due to pressure upon the renal vessels and solar plexus. A right sided tumor involving the perirenal structures may give rise to gastric symptoms due to pressure upon the duodenum, and also biliary symptoms through interference with the structures passing through the gastrohepatic omentum. Large tumors interfering with the vena cava or iliac veins may lead to unilateral or bilateral edema of the lower extremities. Although diarrhea had been considered an important symptom, many of the reported cases have had no interference with bowel function, and 28 per cent of the Mayo Clinic series suffered from constipation. Systemic symptoms, such as loss of weight, cachexia and anemia, depend upon the nature of the tumor, whether it be benign or malignant, and the degree of interference it offers to

important intra-abdominal viscera. A common symptom is the presence of neuralgic pain in the leg due to pressure upon nerves.

The ability to palpate a retroperitoneal tumor will naturally depend upon the size of the tumor mass. Small tumors as a rule cannot be palpated. At times a good x-ray film will disclose the tumor but usually it is necessary to resort to indirect examination in order to establish its presence; that is, Roentgen examinations of organs secondarily involved in the growth of the tumor. In perirenal tumors a flat film of the genitourinary tract may disclose a rotation of the renal silhouette; or a distortion of the pelvis or ureter becomes evident in the course of intravenous or retrograde pyelographic studies. On the other hand, one may be able to establish the presence of such a tumor by means of a barium meal or enema, noting the presence of dislocation or compression of the various segments of the gastrointestinal tract. It has also been suggested that the use of pneumoperitoneum may be of aid in establishing a diagnosis. Cystoscopic procedures in perirenal tumors may be useful in establishing the presence of retention within the renal pelvis, or the presence of obstruction due to angulation of the ureter or ureteropelvic juncture. A film taken with the opaque catheter in situ may disclose a deviation of the ureter from its normal course from pelvis to bladder due to distortion from pressure. Abnormal elements in the urine obtained from the affected kidney simply confirm the presence of irritation of that kidney or of a superimposed infection within it. At times, the use of a lateral pyelogram may reveal a change in contour which is entirely absent in the anteroposterior film.

#### CASE REPORT

Mr. R. D., aged 39, married and the father of two children, was first seen April 4, 1931, complaining of pain in the right loin of one year's duration. The pain was intermittent, of a dull, aching character and was accentuated when lying on his back. There was no increase in

urinary frequency, dysuria or hematuria. The only symptom referable to the gastrointestinal tract was belching. He had lost no weight and noted no edema.

it was in no way connected, and alongside the hilus of the kidney and extending from the transverse process of the first lumbar vertebra to the transverse process of the fourth lumbar



FIG. 4. Photomicrograph, low power ( $\times 200$ ), showing the whorl arrangement of the connective tissue cells.



FIG. 5. Photomicrograph, high power ( $\times 600$ ), showing the character of the individual fibroblasts.

Five years previously he had an attack of right lumbar pain which was believed due to "gravel." The remainder of the history was entirely negative.

Save for an indefinite, small, painless, oval mass situated in the right hypochondrium, the physical examination was essentially negative.

Cystoscopy was negative. Urinalysis was negative.

*X-Ray Examinations.* Intravenous pyclography revealed the left kidney entirely normal. The right kidney, which was definitely diminished in size, appeared to be pushed upwards and outwards under the right leaf of the diaphragm. The pelvis disclosed a fold, giving the impression that there was something rotating the pelvis upward toward the kidney. The calices were normal, while the ureter disclosed a downward bowing, the extent of the arc being from the twelfth rib above to the third transverse process below. (Fig. 2.) There was no evidence of pelvic or ureteral ectasia.

A gastrointestinal examination failed to show any pathology in the stomach or intestines. One could clearly define an ovoid shadow about the size of a large hen's egg situated above the hepatic flexure of the colon to which

vertebra. (Fig. 3.) This same shadow could be visualized on several films.

*Preoperative Diagnosis.* Perirenal tumor causing distortion of the pelvis of the right kidney.

*Operation.* On April 6, 1931, under spinal anesthesia the right kidney and perirenal space were exposed through a 7 inch Albarran incision. The kidney was slightly diminished in size and pushed upwards and outwards under the dome of the diaphragm. Situated along the mesial border of the kidney and extending from the pelvis downward below the lower pole of the kidney, there was a nonlobulated, smooth, ovoid tumor of firm consistency, about the size of a large hen's egg, fixed to the fascia of the quadratus lumborum muscle. Extending from the lower pole of the tumor there was a small duct-like structure about 1 inch in length which appeared to terminate into and blend with the fascia of the quadratus lumborum muscle. The ureter was pushed downward by this tumor. (Fig. 2.) There was no intimate connection between the tumor itself and the kidney or its pelvis and ureter. The tumor was easily dissected away from its bed and removed. The wound was closed in layers over a packing

placed into the bed of the tumor to control oozing, and a rubber tube to the renal fossa.

The wound healed by primary union and the

hemorrhage. The presence of iron pigment granules within phagocytes, in their vicinity, indicates previously resorbed hemorrhage. (Figs. 4 and 5.)

*Diagnosis.* Retroperitoneal fibroma.

A study of the genitourinary tract following the removal of the tumor disclosed no abnormalities. The pyelogram of the right kidney was normal. (Fig. 6.) There has been no recurrence of the old symptoms up to the present writing.

#### SUMMARY AND CONCLUSIONS

1. About 57 per cent of retroperitoneal tumors occupy the lumbar region.

2. Retroperitoneal tumors occupying the lumbar region practically always affect the kidney, yet in spite of this, very few instances have been reported in which the symptoms were referable to the genitourinary tract.

3. When symptoms pointing to renal involvement are obtained, the tumor has caused distortion of the kidney, pelvis or ureter. Distortion may result from:

(a) Direct pressure of the tumor upon the kidney or ureter

(b) Retraction resulting in:

(1) Rotation of the kidney upon its vertical or horizontal axis

(2) Compression or angulation of the pelvis

(3) Compression or dislocation of the ureter.

4. Retroperitoneal tumors arise most frequently from the retroperitoneal lymph nodes, connective tissue around the spine, sheath of vessels, iliac region, pelvis, and about the kidney. They may also arise from the endothelium of the lymphatic radicles around the kidney.

5. More than half of these tumors are malignant and of these, the vast majority are sarcomata.

6. Most of the reported tumors have been large.

7. Symptoms depend upon the size of the tumor and the pressure it exerts upon neighboring structures. Abdominal pain,



FIG. 6. Retrograde pyelogram taken after the removal of the tumor.

patient was discharged from the hospital on the fourteenth day after operation.

*Pathologic Report.* Dr. H. A. Jaffe, pathologist of the Hospital for Joint Diseases reported as follows:

*Gross.* The specimen consists of an encapsulated retroperitoneal mass measuring  $7 \times 5 \times 4$  cm. On section the neoplasm appears as a somewhat edematous and possibly mucinous yellowish-white, rather soft tumor with areas of cystic degeneration.

*Microscopic.* Sections show the tumor to be a fibroma with a loose, edematous, collagenous stroma as demonstrated by von Gieson stain. In places it is relatively acellular, showing only a few spindle cells. In other areas, however, there are numerous immature fibroblasts with large, plump, oval nuclei and a slightly whorled arrangement. Some of the fibroblasts are multinuclear and rich in chromatin. No mitoses are noted, however.

Many of the blood vessels contain organizing, hyaline mural thrombi and show perivascular

neuralgic pain in lower extremities, edema, constipation and the palpation of an abdominal mass are the outstanding symptoms present in the majority of cases of retroperitoneal tumors. Lumbar tumors and particularly those involving the kidney may also give rise to lumbar pain and possibly to increased urinary frequency as a result of irritation of the sympathetic nerves entering the kidney through the renal pedicle.

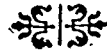
8. Distinctive findings in cases of perirenal tumors causing renal symptoms are: (a) renal rotation; (b) a folding type of distortion of the pyelogram; (c) dislocation or compression of the ureterogram.

9. A case is here presented of a perirenal fibroma leading to distinctive urologic

findings to warrant the diagnosis of perirenal tumor prior to operation.

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THERE is no evidence that urobilin is toxic. It appears to be purely an excretion product. Its reabsorption is of no known value.  
From—"Bile—Its Toxicity and Relation to Disease" by O. H. Horrall (University of Chicago).



# SUBPHRENIC ABSCESS WITH BRONCHIAL FISTULA

## REPORT OF A CASE

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ACCORDING to Steele<sup>1</sup> the rupture of a subphrenic abscess into a bronchus is a relatively rare occurrence. This author was able to collect but thirty-three proved cases from the literature, although he cites Piquand<sup>2</sup> as having collected 112 cases in 1909: many of these, however, were not proved. Steele adds six out of a total of forty-eight cases of subphrenic abscess operated upon or autopsied at the University of Michigan Hospital from 1926 to 1936. He believes the incidence of the complication to be about 12 per cent and found its mortality to be about 50 per cent, which is about the same as the gross mortality for all cases of subphrenic abscess.

While spontaneous recovery has been reported in a few cases of rupture of a subphrenic abscess into a bronchus, immediate adequate surgical drainage is the treatment of choice (Steele).

The following case is deemed to be of sufficient interest to report:

L. R., male, age 29, was admitted to the Evanston Hospital on December 30, 1936. At 6 P.M. the preceding day, the patient was suddenly taken with very severe abdominal pain which persisted until his operation. He was seen by Dr. Frederic W. Burcky on the morning of December 30, and immediately sent to the hospital.

On admission, there was board-like rigidity of the abdomen, a leucocyte count of 18,100 and x-ray examination, with the patient lying on his side, disclosed a marked pneumoperitoneum. His past history was unimportant save for an appendectomy for acute appendicitis in April 1936 and the fact that for some time previous to admission he had suffered from abdominal pain coming on two to three hours after meals and relieved by soda bicarbonate.

At operation a 2 mm. perforation was found on the anterior surface of the first portion of the duodenum. A considerable quantity of turbid green fluid and pieces of food were present in the abdominal cavity. There was a fibrinous exudate upon the adjacent portions of the stomach, duodenum, gall-bladder, and liver. The perforation was closed by a linen purse-string inversion, reinforced by six interrupted linen sutures across the axis of the duodenum. Over this, omental fat was tacked in place by interrupted chromic sutures. The abdominal wall was closed as one layer with interrupted through-and-through sutures. No drainage was employed. Five hundred c.c. of citrated blood was given.

The post-operative course was at first uneventful. On the eighth day the pulse was 80 to 90 and the temperature 99 to 99.8 degrees. Three days later the pulse and temperature began to increase. A small wound infection cleared up under boric dressings but the temperature and pulse remained elevated. On the twenty-first postoperative day, coughing had become troublesome and there was pain in the right lower chest with signs of fluid. On the twenty-fourth day, there was pain in the right shoulder and the leucocyte count was 16,000. By this time, Roentgen examinations had demonstrated an unquestioned subphrenic abscess.

On the twenty-eighth day, the first stage of the operation for drainage of a subphrenic abscess was carried out. A longitudinal incision was made over the right ninth rib in the axillary line. The rib was exposed, the periosteum was shelled back and about 3 inches of rib was resected. The pleural cavity was uninvolved in the inflammatory process. The pleura on the lateral wall of the chest was sutured to that lying over the dome of the diaphragm about  $2\frac{1}{2} \times 1\frac{1}{2}$  inches exposed in the floor of the wound. This area was packed with iodoform gauze.

On the next day, before the opening in the diaphragm could be carried out, the patient

began to cough up great quantities of grayish pus. The foot of the bed was immediately elevated. Despite the fact that nearly a liter of pus was coughed up, it was feared that the bronchial tree was inadequately emptied. Aspiration of the bronchi through a bronchoscope accordingly was carried out by Dr. T. C. Galloway. The diaphragm was cut through by the cautery, but the abscess cavity was not encountered. A vaseline gauze drain was placed in this subphrenic cavity, and a few days later pus began to drain from it freely. During the coughing up of pus (puroptysis) and the bronchoscopic aspiration, the patient's condition had been very poor, but thereafter he began to improve rapidly. The puroptysis subsided entirely and the thoracotomy wound

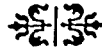
healed. The patient gained some 40 pounds and regained his full health.

#### SUMMARY

Rupture into a bronchus is a rare but serious complication of subphrenic abscess. The possibility of this occurrence should be a factor in determining the optimum time of drainage of a subphrenic abscess. A case of subphrenic abscess with bronchial fistula is reported.

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CAVITIES [empyema] that cannot be obliterated spontaneously are in most instances due to improper management earlier in the course of the disease. They are usually found either in cases in which a free open drainage was instituted at too early a period or in cases in which adequate drainage had never been provided.

From—"Surgical Diseases of the Chest" by Evarts A. Graham, Jacob J. Singer and Harry C. Ballou (Lea & Febiger).

# CHORIONEPITHELIOMA

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**C**HORIONEPITHELIOMA, as the name implies, is a malignant tumor originating from the chorionic epithelium. It was first described in 1877 by Chiari, who called it carcinoma of the uterus. In 1893, Sanger called this neoplasm sarcoma uteri deciduocellulare, but it remained for Marchand in 1895 to recognize the epithelial nature as well as the placental origin of this tumor and apply the correct name.

*Etiology.* There is still a great deal of controversy among the leading authorities concerning the cause of these growths and their exact histologic structure. The writer will not attempt to explain all the different theories and opinions that have been advanced, except to state that it is generally conceded that this disease, in the great majority of cases, occurs sometime during the child bearing period of women following shortly after labor at term, abortion or expulsion of a hydatidiform mole; in a few very rare cases also it has been found in very young girls and elderly women. It has also been reported developing in teratoma of the testis. Most commonly, however, this type of tumor develops in the uterus of multiparous women shortly after the expulsion of a hydatidiform mole.

*Pathology. Macroscopic.* The gross appearance of uterine chorionepithelioma is fairly characteristic. The uterus in early cases is only slightly enlarged, somewhat soft and boggy, the peritoneum covering the uterus, bladder and broad ligaments is very pale and if there are no metastases present or extension of growth into the broad ligaments by continuity, the whole uterus is freely movable. In more advanced cases the tumor mass in the uterine cavity is attached to the endometrium

and infiltrates deep into the muscular wall. It may be palpated when the abdomen is opened by grasping the uterus with one hand.

The tumors resemble either wall thrombi or interstitial nodules with black, thrombosed areas, the base of which may partly slough away. Deep-seated ulcers then develop, or more rarely, there may be a diffuse, fungating, corporeal type of growth. In spite of these variations, a distinctly hemorrhagic appearance, with infiltration of the uterine wall, is noted in all. The tumor area is friable. The growth may penetrate the uterine wall, rupturing through the peritoneal coat into the peritoneal cavity.

*Ectopic.* Chorionepithelioma shows a tumor having no direct anatomic connection with a previous placental site. The uterus may be perfectly normal or may show such hyperplasia of the mucosa and musculature as usually accompanies tubal pregnancy. The site of the chorionepithelioma may be in the vagina, broad ligaments or it may be intraperitoneal. The mass resembles a hematoma or collection of thrombi, tumor cells usually being found only in the periphery, with the main mass consisting of coagulum. The ectopic chorionepithelioma probably arises from a primary uterine tumor that has regressed or been expelled with a placenta or mole, or from the transplanted cells of a possibly normal intra-uterine placenta.

Chorionepithelioma of the Fallopian tube is of very infrequent occurrence. The appearance and symptoms of these cases are similar to those of tubal pregnancy, but recurrence after operation is the rule.

*Microscopic.* Marchand first conclusively showed that the growth originated from the trophoblasts, and that Langhans

cells and syncytium, encountered in the normal villus, also appeared in the malignant tumors. The transition from the

to some degree resembling proliferation of carcinoma. Outgrowths of these cells invade the musculature for a considerable

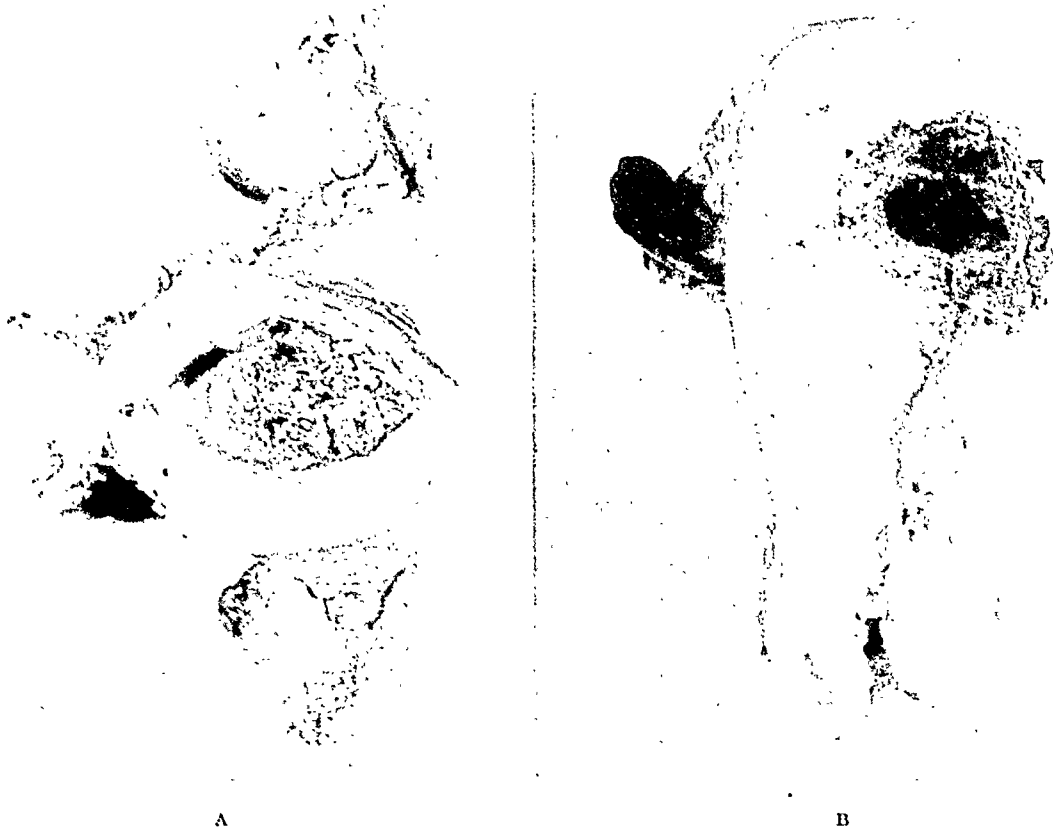


FIG. 1. A, Case 1. Gross specimen, showing tubes, ovaries and uterus, with body of uterus opened anteriorly, containing chorionepithelioma. B, sagittal section of uterus, with chorionepithelioma shown infiltrating deep into the musculature of uterus.

normal villus to hydatid mole is gradual, and a further step towards malignancy is shown in chorionepithelioma. The invasive character of the growth is always present.

Marchand has divided chorionepithelioma into two types, the typical and the atypical. The typical chorionepithelioma resembles the trophoblasts of early pregnancy. The clearly defined polygonal Langhans cells, with well-marked cell outline and large nucleus, appear mixed in with multinuclear groups of dark wandering cells of syncytium. The growth contains numerous blood sinuses, some of which harbor tumor cells as well as hemorrhagic and necrotic areas. No multiplication of villi takes place.

In the typical chorionepithelioma there is a marked tendency for the cell masses to arrange themselves in alveolar groups,

distance. Surrounding the hemorrhagic tumor, there is an area of fibrin and hemorrhage, and still farther toward the periphery there is a marked reaction zone.

Characteristic of this type of growth is the fact that no new formation of connective tissue or of blood vessels takes place. The blood vessels of the host are frequently penetrated and intravascular extension is not uncommon. Even a so-called typical chorionepithelioma may vary greatly in the number of Langhans cells and syncytium, the one or the other form predominating in a given portion of the same tumor or in different tumors. The Langhans cells vary more in size, shape and staining reaction of the nucleus than do normal Langhans cells. Mitosis may be present.

The atypical form generally shows a more diffuse invasion of maternal struc-

tures by large mono- or polynuclear, deeply staining cells, which may suggest sarcoma. The cells may be discrete or form



FIG. 2. Microscopic section of specimen in Case 1, showing the typical polygonal Langhans' cells.

syncytial groups and masses. Langhans cells are much less numerous than in the typical variety and may be so few as to escape observation, unless diligent search is made. As in the typical form, coagulation necrosis, fibrin, and a surrounding reaction zone are found.

From a microscopic pathologic view there are a number of subdivisions and gradations between the typical and the atypical types of this neoplasm; hence the controversy among the pathologists with reference to the diagnosis and prognosis in a given case. After an exhaustive study, Ewing has attempted to base prognosis upon histology, and in the opinion of the writer this seems logical. Ewing believes that the clinical course can be correlated with the histologic structure in such a fashion as to enable the pathologist to give

a definite prognosis. This seems to be asking too much of the pathologist, but probably a relative prognosis may be given. Ewing takes a stand rather different from that of other pathologists, such as Marchand, Schlagenhauser, Aschoff, Frank, Hirschmann and Cristollette, who maintain that the histologic differentiation cannot be utilized in making a prognosis.

In a review of the literature, Wimpfheimer found eighty-five cases of chorionepithelioma that were classified into four types; a typical chorionepithelioma with an approximately equal number of Langhans and syncytial cells, and forty-nine cases classified by histology and treatment as follows:

		No. Cases			Total
		Unoperated	Operated	Died	
Typical Chorionepithelioma	Unoperated	18	1	18	19
	Operated	11	18	11	
Without syncytium	Unoperated	4	2	3	10
	Operated	6	4	6	
Atypical Langhans cell type	Unoperated	2	0	2	6
	Operated	1	1	1	
Atypical syncytium type	Unoperated	12	2	10	20
	Operated	8	1	4	

From these rather scant data, we conclude that the consensus of opinion that the histologic criteria cannot be relied upon, is fully justified, except that where villi are present radical operation offers excellent hope of cure, and that syncytial tumors are fully as malignant as the typical varieties. Out of the eighty-five cases, fifty-one, or 60 per cent, died and thirty-four, or 40 per cent, recovered. The writer believes that this or any other disease that has a 60 per cent mortality is deserving of more thorough study and careful treatment.

**Metastases.** Metastatic extension may occur earlier in this than in any other form of tumor. Dissemination takes place through the blood stream. Metastases

have been found in almost every organ of the body, but the lungs and the vagina are the two sites of election.

*Symptoms.* The most important symptom of chorionepithelioma is hemorrhage. The bleeding may first appear in the early months of pregnancy, shortly after the termination of pregnancy, whether this be normal or hydatidiform, or after a period of latency existing for months or sometimes years. The bleeding is generally slight in the beginning and often repeated until profuse uterine hemorrhages take place; in fact, hemorrhage may be a terminal symptom. It sometimes simulates ruptured ectopic pregnancy, i.e., when the uterus ruptures and there is profuse intraperitoneal hemorrhage. The uterus may be found enlarged, boggy and resembling subinvolution. Subperitoneal nodules may be felt, and enlarged cystic ovaries may likewise be noted. There are generally symptoms of anemia, slight or moderate elevation of temperature, and a feeling of intense lassitude. A brief summary of a typical case would be: repeated or constant uterine hemorrhage, anemia with a low degree of sepsis, enlargement of uterus, metastases, cachexia and death.

*Differential Diagnosis.* Chorionepithelioma must be differentiated from ordinary non-malignant retained products of conception. Here the specimens removed with a sharp curette or a sponge forceps are rather characteristic. Such tumors as carcinoma, sarcoma and necrotic submucous fibroids may have to be excluded by microscopic section.

The most characteristic symptom of chorionepithelioma is the repeated findings of small particles of chorionic tissue in serosanguinous fluid flowing from a uterus that has been thoroughly emptied. If this symptom occurs shortly after expulsion of an hydatidiform mole, it is very suggestive of chorionepithelioma. Major importance must now be accorded to the pregnancy urine test. The writer has used the Friedman modification of the Aschheim-Zondek test with much satisfaction. In a case where

the above symptoms are very definite and the Friedman test is very positive with only 10 per cent of the amount of urine usually used, one is justified in making a diagnosis of chorionepithelioma.

The incidence of chorionepithelioma, as given by different authors, varies greatly. With diligent search of the literature in 1919, Vineberg found 533 well authenticated cases. It is stated by Polloson and Violet that 45 per cent followed hydatidiform mole. The writer has personally encountered three cases, all following the expulsion of hydatidiform moles, and after review of the literature finds that few have personally treated more cases; hence the difference of opinion.

*Prognosis.* The virulence of this disease varies tremendously. In many instances the fulminating nature can be compared only to that of melanoma. In other cases spontaneous regression appears to have occurred, but in the opinion of the writer this seems to be a mistaken diagnosis.

*Treatment.* Early diagnosis is most essential. In fact, it is of the utmost importance. Where chorionepithelioma is strongly suspected, the writer would very emphatically advise against the use of the curette, since even in the hands of an expert, it is dangerous in such cases. As soon as a positive diagnosis is made, a complete abdominal panhysterectomy is indicated. In early cases, where the ovaries are normal, one ovary may be left to continue the ovarian function without danger of metastases. If a positive diagnosis of chorionepithelioma is made in young women and if there is an element of doubt, the patient should be prepared for radical operation; when the abdomen is opened, the surgeon, with the situation in perfect control, may do a hysterotomy safely, to be absolutely sure of the diagnosis. If there has been an error, the uterus may be closed and no harm has been done. If the diagnosis is confirmed by the hysterotomy, a panhysterectomy is performed at once. In all such cases in which the diagnosis is made early and the

growth is confined to the endometrium and the musculature of the uterus, the prognosis is good, if the proper operation

when she passed a hydatidiform mole the size of a grapefruit. Dr. Rolf kept her in bed one week after this. Then she resumed some of her



FIG. 3. Case 11. Gross specimen, showing cavity of uterus, with chorionepithelioma infiltrating deep into the musculature.

and treatment is carried out. In inoperable cases, radiotherapy, using radium and x-ray, has been used with favorable results by Keene, Lackner, Wintz and others; but Hofbauer has but little, if any, faith in radiotherapy.

The following cases were encountered by the writer:

**CASE I.** Referred by Dr. J. Rolf of Covington, Kentucky, Mrs. F. N., age 39, was the mother of five children, the youngest of whom was 5. She had had no miscarriages and no previous illness. Her last regular menstruation was October 23, 1934. On December 4, 1934, she menstruated for one day. On December 18, there was profuse menstruation lasting four days, and then dribbling until January 3, 1935. Thick blood clots were passed and were followed by irregular bleeding.

I first examined her on January 9, 1935, and found the uterus in normal position, somewhat enlarged, with all the symptoms and signs of a normal pregnancy that had been threatening to miscarry. I advised rest in bed and morphine as necessary. She remained in bed a few days, then was up part of the time. She had slight uterine hemorrhage at times until February 24,

household duties, but soon began to bleed again when she moved about. There was a continuous serous discharge, containing occasional small pieces of chorionic tissue. This continued with occasional moderate hemorrhage until March 24, 1935. I examined her again, finding her somewhat pale and complaining of a feeling of lassitude. The pelvic organs were normal except for a slight enlargement of uterus with indication of subinvolution, as one would expect to find shortly after a miscarriage.

On March 24, 1935, a Friedman modification of the Aschheim-Zondek pregnancy test was done, using 12 and 6 c.c. of urine on successive days. The results were positive. The test was repeated three days later using only 2 and 1 c.c. of urine, and the results were again positive. The patient entered the St. Elizabeth Hospital, and three days after the second urine test, a panhysterectomy was done, removing both tubes and ovaries and covering all raw surfaces with peritoneum as usual. The appendix was also removed.

**Clinical Findings.** There were no adhesions. The uterus, tubes and ovaries seemed approximately normal, except that the uterus was slightly enlarged and soft. The peritoneal covering of the uterus, bladder and broad

ligaments was very pale, out of all proportion to the moderate anaemia present. A chorionepithelioma the size of a large olive was found in the fundus, attached to and infiltrating deep into the posterior wall of the uterus. (Fig. 1.)

Another Friedman test was made twelve days after operation and found negative. The patient made an uninterrupted recovery and left the hospital two weeks after operation. She has remained well with no signs of metastases up to the present writing (eighteen months after operation).

**CASE II.** Referred by Dr. J. E. Dawson. Mrs. M. K. age 23, had been married three years and was the mother of one child, 16 months of age. Her family history was negative, and she herself had had no previous serious illness. Her menstrual history before the first pregnancy was normal, but menstruation became irregular after the birth of her baby. The last menstruation had occurred October 2, 1935; there was continuous slight bleeding from November 8 to December 20, 1935, when she passed a hydatidiform mole, accompanied by a very profuse hemorrhage.

She was removed to the hospital at that time and remained there ten days. After this hemorrhage her red cell count was 1,900,000. She improved, but continued to have a serous watery discharge with the intermittent passage of small pieces of chorionic tissue until January 16, 1936, when a moderate uterine hemorrhage occurred. Another blood count was made January 22, 1936, which revealed 3,440,000 red cells and 11,880 white. She again entered Speers Hospital on February 1, 1936. A Friedman modification of the Aschheim-Zondek test was done February 6, 1936, using only 2 and 1 c.c. of urine on successive days. The result was strongly positive. She had a slight hemorrhage February 9, 1936.

We operated February 10, 1936, doing a panhysterectomy, removing both tubes and left ovary. The right ovary, which seemed perfectly normal, was left in place, since the patient was young (23), and since the writer believes that there is no danger of metastases in this case. The appendix was also removed.

**Clinical Findings.** The appendix was normal; there were no adhesions; the tubes and ovaries appeared normal, the uterus slightly enlarged, soft with a patulous external os. The peritoneum covering the uterus, bladder and broad ligaments was very pale, out of all proportion to the moderate anemia present at that time. The uterus, on section, revealed

a chorionepithelioma attached to and filling the fundus, infiltrating deep into the uterine wall. (Fig. 3.) Recovery was uneventful.



FIG. 4. Microscopic section of specimen in Case II, showing the presence of Langhans' cells.

The Friedman test was repeated February 26, 1936, just sixteen days after operation, using 15 and 10 c.c. of urine on successive days. This test was negative.

The patient left the hospital February 29, 1936, and has made a complete recovery. She has gained 15 pounds in weight and feels well. Another blood count was made April 16, 1936, about two months after the operation, which was as follows:

Red.....	5,300,000
White.....	9,750
Hb.....	70 per cent
Polys.....	54 per cent
Lymphocytes.....	35 per cent
Monocytes.....	3 per cent
Eosinophiles.....	7 per cent
Basophiles.....	1 per cent

**CASE III.** This case was reported in the Cincinnati Lancet Clinic, March 29, 1914, but as it resembles the other two cases, I will review it briefly. This patient was referred to me by Dr. O. W. Brown. Mrs. M., age 20, had been married one year and had no children. She had had one miscarriage at three months in



June, 1913, and was curetted a few days later to remove pieces of retained placenta. The family history was negative. She had had no previous illness, but was neurotic and had attacks of hysteria.

Her last normal menstruation was on October 20, 1913. Three or four weeks later she began to have all the symptoms of pregnancy, with nausea and vomiting, amenorrhea, etc. She had several slight uterine hemorrhages previous to January 23, 1914, when she had a copious hemorrhage. She entered Speers Hospital, and four days later passed a hydatidiform mole. She made an uneventful recovery and returned home ten days after passing the mole. After being home two days, she began bleeding slightly again, at intervals. On February 20, she again had a profuse hemorrhage and entered the hospital. A small mass was removed from inside the fundus of uterus with a small forcep. Dr. Woolley (then Professor of Pathology, University of Cincinnati) made frozen sections of this tumor and pronounced it a chorionepithelioma and advised immediate radical operation, which was done the next day, February 22, 1914. Both tubes, ovaries, the whole uterus and the appendix were removed. The patient made a rapid recovery and is living and well at present—twenty-two years after operation. No pregnancy urine tests were made, as they were then unknown.

### CONCLUSIONS

1. All patients who have expelled hydatidiform moles should be kept under observation six months or longer, with a pregnancy test done each month, this determines if any living chorionic tissue is present.

2. If there is a serosanguinous discharge from the uterus, containing particles of chorionic tissue, soon after a pregnant uterus has been emptied at or before term, it is very suggestive of chorionepithelioma.

3. According to statistics given by some writers, chorionepithelioma is very rare, and that to see three cases of chorionepithelioma, I should have to see 100,000 or 150,000 pregnancies. I do not believe that it is such a rare disease as has been pictured in the literature.

4. I believe that if general practitioners, obstetricians and gynecologists are alert,

they will recognize the symptoms here described and diagnose more cases of chorionepithelioma.

5. The prognosis is good if the diagnosis is made early as it was in all three cases here reported. These patients are living and well, but the operation, as described in this report, must be performed early.

I wish to thank Dr. Alfred Glazer, pathologist at St. Elizabeth Hospital of Covington, Kentucky, for his cooperation and excellent pathological work on these cases; also to express my appreciation and thanks to Professor Hofbauer, Professor of Gynecology and Professor Richard Austin, Professor of Pathology at the Cincinnati University, for their cooperation and reading of these sections.

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# SECONDARY RESECTION OF THE INTESTINE FOR RECURRENT CARCINOMA\*

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**M**ALIGNANCY of the gastrointestinal tract is a fairly common disease, comprising about 50 per cent of all malignancies. In spite of early diagnosis and early intervention, its operative removal is attended by a varying mortality of from 5 to 35 per cent in different surgeons' hands. Following successful removal, there is a high incidence of recurrence and metastatic spread. It is little wonder, then, that doctors and patients when confronted with this condition assume an attitude of defeatism, and in the presence of postoperative recurrences, a complete feeling of hopelessness.

Recurrences and metastases following resection of large intestine malignancies are unfortunately all too common, even in those portions of the large intestine that, from a technical point of view, lend themselves to easy eradication. Recurrences are prone to occur in the intestine at the site of intestinal anastomosis following resection, in the abdominal scar and in the exposed colostomy opening. This occurs especially in the exteriorization or Mikulicz type of operation. Metastatic spread occurs in the regional draining lymph nodes, over the peritoneal surface and in the thoracic and abdominal viscera.

There are few successful reports in the literature of arrests or cures of intestinal malignancy following reoperation for recurrences or metastases. Thompson recently reported several cases, and quotes Rankin and Judd of the Mayo Clinic as having had little success with attempts at secondary removal of intestinal malignancies following recurrences. The fact that such successful results can be occasionally obtained

should be reported in order to encourage and stimulate surgeons to attempt reoperation in an otherwise hopelessly doomed patient. This is the purpose in presenting the following case.

## CASE REPORT

Mrs. E. W. aged 55, was admitted to the Hospital for Joint Diseases on March 8, 1931. During the previous two months, she had become increasingly constipated and passed bloody and tarry stools. She also complained of loss of appetite and a feeling of weakness. There had been no pain, nausea or vomiting.

The physical examination was essentially negative. The abdomen was somewhat distended, but no masses could be felt.

X-ray examination of the gastrointestinal tract revealed a constricting annular neoplasm of the sigmoid.

On March 9, 1931, under general anesthesia, the patient was operated upon. Upon opening the abdomen, the large intestine was found distended. The circular neoplasm reported in the x-ray was found in the sigmoid. The Mikulicz operation was decided upon, and a loop of colon, containing the growth, was mobilized outside the abdomen, and the wound closed about it. Three days later, the afferent and efferent limbs of the intestine were sectioned with the cautery and the growth removed, leaving the patient with a double barreled colostomy.

*Pathologic Report* (Dr. H. L. Jaffe). Sections of the tumor showed an advanced adenocarcinoma infiltrating the muscular coat and appearing in the serosa. The tumor was fully developed and malignant. Diagnosis—papillary adenocarcinoma of the sigmoid.

The patient was discharged on March 26, 1931, and returned to the Hospital on May 5, 1931, when the spur between the limbs of the colostomy was crushed with a crushing clamp.

\* From the Surgical Service of the Hospital for Joint Diseases, New York City.

The colostomy gradually closed, and the patient had normal bowel movements. After several weeks, the colostomy reopened.

On September 14, 1931, the patient reentered the Hospital for a closure of the colostomy opening. After excising the scar and separating the mucosal edges of the intestine, the stoma was closed with inverting Lembert sutures. The skin and fascia were closed. A hard nodule excised from the intestinal mucosa was reported carcinoma.

Following this operation, the fistula remained closed for several months and then again reopened. A nodule which gradually increased in size, was noticed in the colostomy opening. Most of the fecal discharge was through the colostomy opening, with occasional bowel movements. In August 1932, radium needles were inserted into the recurrent malignant nodule. There were no visible effects, the tumor continued to grow, and a further radical removal was decided upon.

On January 24, 1933, under general anesthesia, an elliptical incision was made around the fistulous opening, and this incision was extended into the peritoneal cavity. The afferent and efferent limbs of the colostomy were resected together with the elliptical portion of the abdominal wall containing the recurrent growth. An end-to-end anastomosis of the intestine was performed, the abdominal wall closed in layers, and rubber dam drains inserted to the site of the anastomosis. The wound healed by primary union, the drains being removed after eight days. The mass was reported to be adenocarcinoma of the intestine, recurrent. The patient made a good recovery, and has continued well to date, with normal functioning bowel movements.

The unusual outcome in this case as the result of rather fortuitous circumstances

suggests that it might be deliberately worthwhile maintaining an open colostomy for a considerable length of time following a Mikulicz operation. Since many recurrences take place in the intestinal wall at the site of amputation of the gut, it would be very easy to detect such recurrences if the intestinal ends were kept exposed in the colostomy opening. This happened in the above case. If, after a reasonable period, no recurrences are demonstrable, it would be safe to close the stoma and reestablish the intestinal continuity. The efferent portion of the intestine could be kept patent with irrigations and enemata.

This patient died on January 21, 1938. For a number of months prior to death she complained of pain in the back, chest and lower quadrant. Autopsy showed a generalized metastatic spread, involving the lungs, liver and retroperitoneal lymph-nodes.

#### SUMMARY

1. A case of secondary resection of the intestine for recurrent carcinoma, well six years after operation, is presented.

2. The suggestion is made to deliberately maintain a functioning colostomy in order to detect recurrences in the intestinal wall. If none occur after a reasonable period of observation, closure can be attempted.

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# MESENTERIC CYSTS CAUSING INTESTINAL OBSTRUCTION\*

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AT first thought there seems to be very little justification for reporting a single case of an established disease entity from which no significant conclusion can be drawn and which resembles previously reported cases in most of its principal features. However, in dealing with a comparatively rare condition it is well to realize that only through the accumulation of such data will the true clinical manifestations become apparent. It is with this thought that the following case report is submitted.

Since Benvieni,<sup>1</sup> in 1507, first reported mesenteric cysts, the literature has been increased by reports of either single instances or small series of cases. Dowd,<sup>2</sup> in 1900, stated: "Reports indicate that mesenteric cysts are being removed as often as once a month." He himself reported 145 such cases. Higgins and Lloyd,<sup>3</sup> in 1924, numbered the reported cases at about 245. Miller<sup>4</sup> stated that there were less than 400 cases of all types recorded up to 1935.

The main features of interest are the theories of origin and formation, and the complications which develop. The former find expression in the many classifications, while the latter determine to a large extent the clinical picture.

Braquahaye,<sup>5</sup> in 1892, offered a classification which included the following types of mesenteric cysts: (a) sanguinous; (b) lymphatic cysts, including chylous; (c) hydatid; (d) congenital and dermoid; and (e) cysts of adjoining organs, such as the ovaries, pancreas, etc. His classification was followed shortly by that of Moynihan's,<sup>6</sup> in 1897, which listed serous, chylous, hydatid, blood and dermoid cysts, and cystic malignant disease.

Dowd divided the cysts into three principal groups:

I. Embryonic, including: (a) dermoid; (b) serous; (c) chylous, and (d) hemorrhagic, and still others with walls like those of the intestine.

II. Hydatid cysts.

III. Malignant disease.

The collection of many types of cysts under the heading embryonic had its influence in the classifications which followed. Ayer added two groups to Dowd's classification as follows: (a) cysts arising from the glandular structures in the intestinal wall; and (b) cysts of normally placed retroperitoneal organs.

Niosi<sup>7</sup> gave the following classification for cysts of the embryonic group: 1. cysts of intestinal origin: (a) sequestration from bowel during development; (b) from Meckel's diverticulum. 2. Dermoids. 3. Cysts from retroperitoneal organs (germinal epithelium, ovary, Wolffian body, Mullerian duct).

Gould's report,<sup>8</sup> in 1915, did not include cysts, but did present tumors of the mesentery, all of which had walls of dense fibrous tissue without an epithelial lining. He thought these resembled very closely the "cold abscesses of the mesentery" which were reported by Beatson (1908), Kukula (1899), and Baum (1902). Tubercle bacilli were found in the contents of the cystic structure reported by Bealson and Kukula, but were not present in any of Gould's cases. Giant cells were also absent.

Swartley<sup>9</sup> writes; "It is plain that more and more are coming to regard all mesenteric cysts not parasitic or malignant, as of embryonic origin. The term 'cystic malignant disease' which has been given as a class of mesenteric cysts is no longer tenable. Malignant cysts are probably for the most part, originally, simple cysts which subsequently have become malign-

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nant. Moreover, a metastatic malignant tumor of the mesentery, or for that matter a primary one which undergoes cystic

rabbit, and man." Hueper,<sup>12</sup> in 1927, wrote of finding a cyst in the subserosa of the wall of the duodenum of one of thirty



FIG. 1. Photograph of the specimen showing groups of cysts adjacent to the bowel, a portion of which is seen in the center of the illustration. A more complete description is given in the text.

degeneration is not morphologically a cyst."

Ribbert's expression of the theory that sequestration of a portion of embryonic tissue or organ may occur and develop in an anomalous manner is discussed by Miller.<sup>10</sup> That this course of events may occur is supported by Dowd, who pointed out the many instances of accessory structures such as lobes of thyroid and thymus glands and breast tissue. Accessory spleens and double spleens have also been reported and an accessory pancreas is occasionally found.

In 1908, Lewis and Thyng<sup>11</sup> described the "regular occurrence of intestinal diverticulæ in the embryos of the pig,

rabbits and cats examined with this anomaly in mind. The cyst had a well developed musculature and mucosa similar to that of the duodenum, but the layers were thinner.

There seems to be little doubt at present that the mechanism of sequestration of intestinal diverticulæ is responsible for many mesenteric cysts. Such a process would lead to formation of cysts, the walls of which resemble very closely those of the adjacent bowel. By a shift in position from the anti-mesenteric border of the gut; Meckel's diverticulum and remnants of the omphalo-mesenteric duct may come to lie between the folds of the mesentery and give rise to cysts in the walls of which

may be found layers similar to those of the gastrointestinal tube.

Dermoid cysts which are intra-abdom-

behind the developing peritoneum and subsequently coming to lie between the peritoneal layers of the mesentery consti-

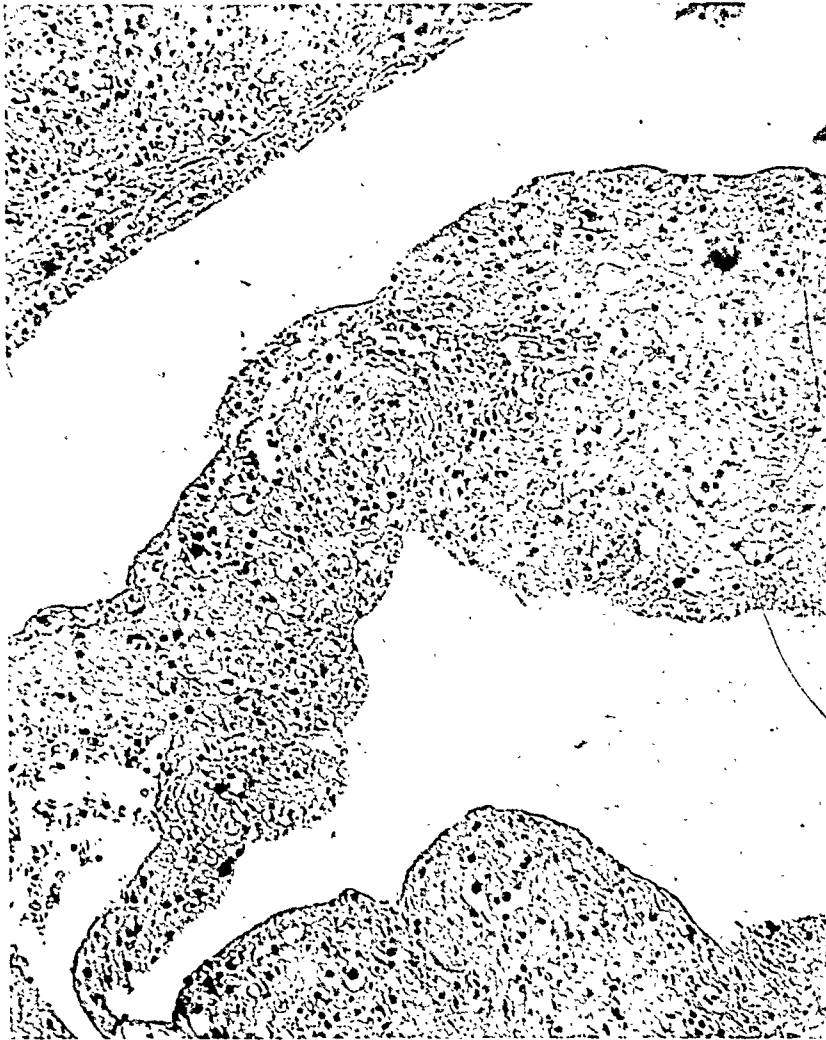


FIG. 2. Photomicrograph of cyst wall showing hyaline and amorphous material. There is a definite limiting membrane lining the cyst.

inal are said to originate in the ovary. Swartley, in 1927, stated that dermoid cysts of the mesentery have been reported thirty-five times. Since all of these have been found in women some authors conclude that their origin is always ovarian.

The general picture becomes somewhat clarified when such a classification as that of Higgins and Lloyd is preceded by their definition of true mesenteric cysts, i.e., "those which occur in or near the mesentery and which are not malignant, dermoid, or parasitic and do not arise in any normally placed retroperitoneal organ." Thus cysts of embryonic origin arising from mesodermal remnants incarcerated

tute one class of true cysts. The others are those of intestinal origin and include cysts arising in most cases from diverticulae of the bowel during the development of the gut, and those which may develop from the persistent portions of the vitelline duct. Those of the latter group are usually identified by microscopic examination. The wall has layers of smooth muscle arranged similarly to those of the intestinal tract. The epithelial lining is dependent somewhat on the degree of tension in the cyst. Simple columnar epithelium is often seen, occasionally stratified layers are present, and cases have been reported in which ciliated epithelium lined a mesenteric cyst.

The presence of goblet cells in the lining of a cyst of this group has been interpreted as additional evidence of intestinal origin.

The other group includes those which have been called serous, lymphatic, chylous or hemorrhagic, according to their contents. Dowd suggested that the contents of such cysts should not be used as a means of classifying them. Both lymph spaces and blood vessels have been identified in the walls of mesenteric cysts. Hemorrhage accounts for the contents of the hemorrhagic cysts. Chyle effuses in chylous ascites and its passage into a cyst cavity from the wall seems to be an example of the same process. In regard to the serous cysts Dowd states, "Whether the fluid is exuded from the blood vessels in the form of serum, or whether it is secreted from the cells which line the cyst seems to be largely dependent on the structure of the cyst wall." Microscopically the wall of cysts of this group is composed principally of fibrous tissue in which round cells may be found. The lining is usually a single row of epithelial cells, but destruction of the lining by inflammation may occur. The small bowel is the site of more than half the reported cases. The mesentery of the ileum contains about one-fourth of the total number.<sup>17</sup> Single cysts are more numerous, the number of multiple cysts being comparatively small. As in other abdominal cysts extremes of size have been observed. The unilocular and multilocular types appear to be equally numerous.

#### CASE REPORT

A white male, aged 14 years, was admitted to the Wisconsin General Hospital July 7, 1934, with a chief complaint of abdominal pain. He had experienced this symptom at intervals since the age of 9. The pain was sharp and cramp-like and occurred usually about an hour after meals. The duration of the attacks was variable, some of them subsiding after a few days while others persisted for weeks. On the advice of his physician he had altered his diet, taking only liquids and soft food in smaller quantities than usual, but with more frequent feedings. This régime

afforded moderate relief. The patient had vomited with the first attack, and also during the attack for which he was hospitalized. During the intervening period of five years the seizures of abdominal pain had not been accompanied by emesis. The attacks started after scarlet fever in 1927. In 1930, Roentgen ray pictures of the stomach were taken and an ulcer was thought to be present. Many types of ulcer treatment were instituted, none of which altered his abdominal condition. There had been a weight loss of 20 pounds since April 1934. The remainder of the history was not significant except that mild constipation had persisted over a period of years for which mineral oil was given.

The pertinent findings on physical examination were confined to the abdomen. There appeared to be no distention, but generalized increased tone of the abdominal muscles, especially the recti, was noted. There was slight tenderness in the entire epigastrium. No masses were palpable. The liver edge reached the costal margin. There was no fever. The pulse and respiratory rates were within normal limits.

The urinalysis on admission revealed a specific gravity of 1.029. The urine was acid in reaction; showed a faint trace of albumin and no glucose, but was positive for acetone. Microscopic examination showed three fine granular casts per ten low power fields; occasional squamous epithelial cells, a few bacteria, and one to two white blood cells per high power field. The blood count was as follows: hemoglobin 90 per cent; red blood cells, 6,160,000; white blood cells, 13,150; neutrophils, 70 per cent; eosinophils, 2 per cent; and lymphocytes, 28 per cent. The Wasserman reaction was negative. The blood sugar was 77 mg. per cent, and the non-protein nitrogen was 30 mg. per cent. A tentative diagnosis of pyloric obstruction was made.

During the period of observation the urine was examined for lead on two separate occasions and none was found. Through the fluoroscope, barium, which had been administered to the patient elsewhere prior to his admission, was visualized in the upper loops of small bowel, and a diagnosis of high intestinal obstruction was made. The cause of the intestinal obstruction was undetermined prior to operation.

On July 14, 1934, under cyclopropane anesthesia an exploratory laparotomy was per-

formed. The abdomen was opened through a mid-right rectus incision and marked dilatation of almost the entire jejunum was seen. A mass was brought up into the wound from the lower part of the abdomen. This mass consisted of several rather large dilatations which were at first thought to be diverticuli of the small bowel. Considerable constriction of the bowel lumen was noted, and because of this finding a resection of approximately 45 cm. of jejunum was done. An end-to-end anastomosis was made and a catheter was inserted into the dilated jejunum above the anastomosis. About 500 c.c. of intestinal contents were removed from the dilated bowel, rendering closure of the abdomen much less difficult. The catheter was brought out through the lower end of the incision which was closed in layers without drainage. The postoperative course was essentially uneventful except for moderate abdominal pain and the development of a mild cystitis. On July 27, eleven days after the operation, the catheter was removed and the jejunal fistula healed rapidly. The patient was discharged from the hospital on August 4, 1934.

The description of the specimen (Fig. 1) removed at operation was as follows: "Specimen consists of a piece of small bowel about 45 cm. in length attached to which are several cysts, the largest being  $11 \times 8 \times 6$  cm., another  $9 \times 8 \times 5.5$  cm. also being present. These cysts can be divided into four groups, each consisting of one large and several smaller cysts. There is communication within the groups, but not between groups. There are several small cysts 1 to 2 cm. in diameter which are separate. The cysts are in the mesentery and do not communicate with the bowel. They are surrounded by a thin fibrous wall and contain brownish fluid without noticeable odor. The cysts are unilocular. Within the bowel wall there is a small firm tumor,  $1 \times 1.5$  cm. Microscopically the section shows numerous spaces varying greatly in size and lined by a single row of cells."

#### SYMPTOMATOLOGY AND DIAGNOSIS

It may be said that the symptoms of mesenteric cysts depend on conditions which most authors list under the heading of complications. The most characteristic symptom complex includes repeated attacks of abdominal pain, usually cramp-

like and accompanied by nausea, vomiting and often abdominal distention. Constipation may be present, and may alternate with or be followed by diarrhea. This sort of history is given in those cases where the encroachment on the bowel lumen has occurred by pressure of the cysts from the outside. Volvulus, intussusception, adhesions or kinking may cause complete obstruction, necessitating operation, at which time the cause of the obstruction may be determined.

The physical examination may aid in the diagnosis if a smooth, rounded, cystic and freely movable mass is palpable. Similar findings are present in cases of omental cysts, but Porter's<sup>13</sup> observation that pain and nausea or vomiting are associated with mesenteric cysts more often than with any other intra-abdominal cyst should help in differentiating omental from mesenteric cysts.

Women are more often affected than men. Most cases are seen in the fourth decade, although Palmer's<sup>14</sup> case and one reported by Sala and Nachmie had pre-natal volvulus from a mesenteric cyst. Volvulus caused by mesenteric cysts was present in Miller's case (four days old), and in Cutler and Merriam's case<sup>15</sup> (three and one-half months). Old age is no assurance that an intra-abdominal lesion is not a mesenteric cyst. Many have been discovered in the fifth and sixth decades.

The lack of general wasting has been considered to be an important point in diagnosis. Jones'<sup>16</sup> patient, and one in the accompanying case report each lost about 20 pounds in the few months prior to operation. These instances, however, represent the exception rather than the rule.

If inflammation occurs in the cyst the differential diagnosis must then include the usual acute abdominal conditions which are accompanied by signs of peritoneal irritation and constitutional reaction.

Swartley lists the complications as follows:

1. Obstruction.
2. Peritonitis as a sequel to obstruction.



3. Hemorrhage into the cyst. This has been known to be fatal.

4. Rupture of the cyst.

5. Torsion of the cyst.

6. Pressure upon organs if the cyst becomes impacted in the pelvis.

Miller writes of the group of cases which do not have any of the above complications and states that the signs and symptoms in this group are not so uniform. Among them are abdominal fulness, pressure, dragging sensations in the abdomen and, occasionally, history of recurrent attacks of very mild intestinal obstruction.

Most authors state that the correct diagnosis has never been made prior to operation, and that this is an indication of the diagnostic difficulties encountered. Warfield,<sup>17</sup> who reviewed the literature from 1920 to 1932, calls attention to correct diagnosis reported by Haworth (1920), Bertolini (1921), Naumann (1921), Levinson and Wolfsohn (1926), Ciarlo (1927), Aloï (1927) and Finucci (1930). Parker,<sup>18</sup> in 1923, made the correct diagnosis from Roentgen ray and fluoroscopic examination. The preoperative diagnosis in the case reported by Hueper was acute appendicitis and mesenteric cyst. The appendix was not found to be acutely inflamed at operation, but the cyst was present in the mesentery of the ileum.

#### TREATMENT

Treatment has received but scant attention in the literature for the reason that it does not differ in the acute cases from that of intestinal obstruction or peritonitis from any other cause.

Enucleation of the cyst or cysts is the operation of choice if it can be done without damaging the blood vessels of the mesentery. Resection of the involved portion of bowel may be necessary. It is accompanied by a high mortality (60 per cent), but such figures include acute cases in which the mortality would be high for bowel resection done for obstruction from any other cause. The acute cases are very ill of a high intestinal obstruction when

the operation is decided upon, so that the high mortality rate is not surprising. Drainage of the cyst may be of value temporarily, but the danger of sinus formation which may ultimately require excision should be remembered. Aspiration and marsupialization are both obsolete, but might be useful in certain instances.

#### SUMMARY

1. A case of mesenteric cysts in a male aged 14 years is reported. The history in this instance was one of recurring attacks of intestinal obstruction over a period of five years, the final attack necessitating surgical intervention. The cause of the obstruction was not determined prior to operation.

2. Resection of the involved bowel was done and an enterostomy above the site of the end-to-end anastomosis was used to decompress the dilated loops of intestine. The enterostomy tract closed promptly and the patient recovered.

3. The case is believed to be one of true mesenteric cysts arising from mesodermal remnants.

4. Two additional instances found in the literature of correct diagnosis of mesenteric cysts before operation or autopsy are pointed out.

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BILE, under ordinary conditions, is sterile, but is not bactericidal. . . .  
 Jaundice is a symptom, not a disease.  
 From—"Bile—Its Toxicity and Relation to Disease" by O. H. Horrall  
 (University of Chicago).

# NON-RECURRENT DISLOCATION OF THE PATELLA

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THE following case report is that of a chronic dislocation of the patella, which existed for twenty-three years long axis and becomes engaged between the condyles of the femur. The following case report is that of a

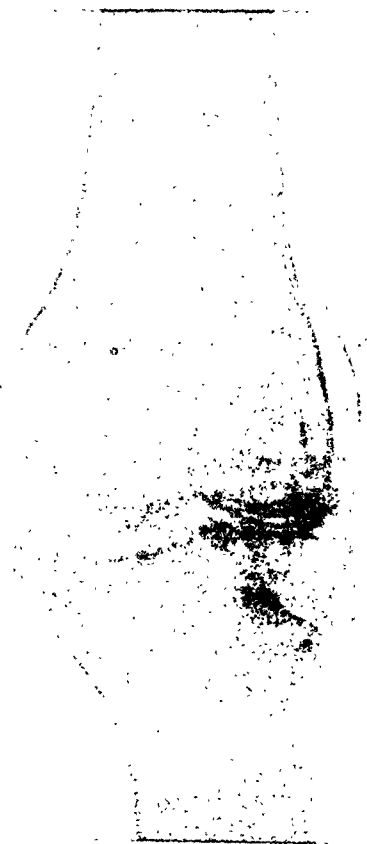


FIG. 1. Anteroposterior view of knee joint, revealing lateral dislocation of patella.



FIG. 2. Lateral view of knee joint prior to operation, showing absence of patella from its normal location.

before operation. Recurrent or habitual dislocation of the patella may result from a congenital abnormality and invariably the patella dislocates laterally. It is usually accompanied by a poor development of the lateral femoral condyle and is most frequently observed in females. The patient soon learns to reduce the patella without assistance. The patella may also be dislocated as result of traumatism when it is usually dislocated medially or rotates on its

chronic dislocation of the patella of the non-recurrent type:

G. M., aged 49, was first observed on November 17, 1929, when she complained of weakness of the left knee. She stated that she was quite well until at the age of nineteen years she was suddenly taken ill with what was then diagnosed as acute articular rheumatism. The left knee had become quite swollen and after several months she was allowed up and about

with the aid of crutches. Since that time, she states, the knee frequently "gave away." Two weeks prior to the initial observation she fell

fixed laterally. There was no evidence of periarticular thickening nor any evidence of arthritis in any of the other joints of the body.

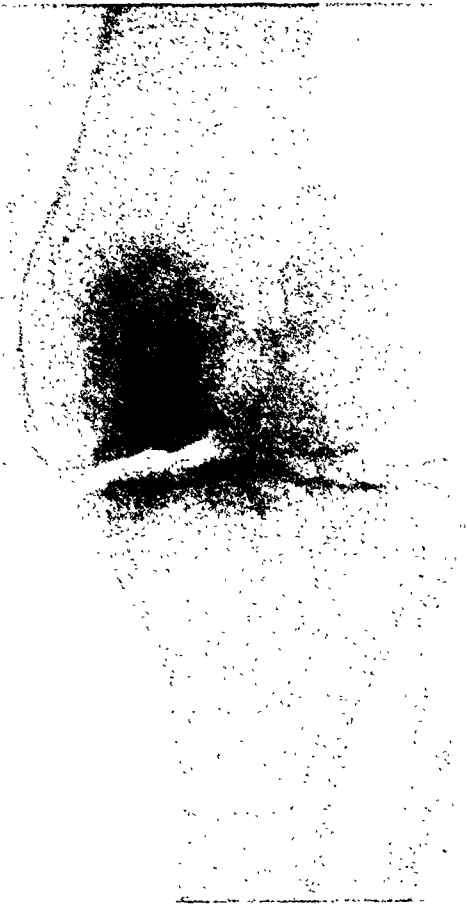


FIG. 3. Anteroposterior view following operation.



FIG. 4. Lateral view following operation.

when her knee gave away and she had had pain and disability since. Several years ago she had sought surgical attention, but was then informed that nothing could be done.

*Examination.* The patient was observed to be in excellent general condition. She walked with a left knee limp and maintained the left knee in an attitude of partial flexion. She walked with the aid of a cane and with an elastic bandage about the knee.

Clinically, it was observed that the left knee was wider than its fellow and flattened anteriorly, and that the patella was not situated in its normal location. The patient could voluntarily extend the knee joint to 155 degrees; passively it could be extended to 180 degrees. The angle of greatest flexion was 75 degrees, whereas the right knee could be flexed to 45 degrees. There was approximately 15 degrees of lateral instability of the joint and marked atrophy of the quadriceps group. The patella was found to be dislocated and

The x-rays disclosed the presence of a lateral dislocation of the patella with a partial subluxation of the tibia and osteophytic production about the condyles of both the tibia and femur. The joint space was narrowed. The tibial condyles were flattened and the spinous processes were very much shorter than normal. In the lateral view the patella could not be observed. Otherwise the joint appeared to be well formed.

The patient was admitted to the Hospital for the Ruptured and Crippled and on December 2, 1929, operation was performed. The joint was prepared in the usual manner and a curved incision made about the knee with the convexity downward, exposing the joint in its entirety as well as the tibial tubercle. The patella was identified and found to be displaced outwardly and firmly adherent in this position. The ilio-tibial band was contracted and tense. This latter structure was then sectioned transversely 1 inch above its distal attach-

ment as were all the contracted tissues on the outer side of the knee joint. It was only after such sectioning that the patella could be

Postoperative x-rays revealed the presence of a normally situated patella.

The patient made an uneventful recovery

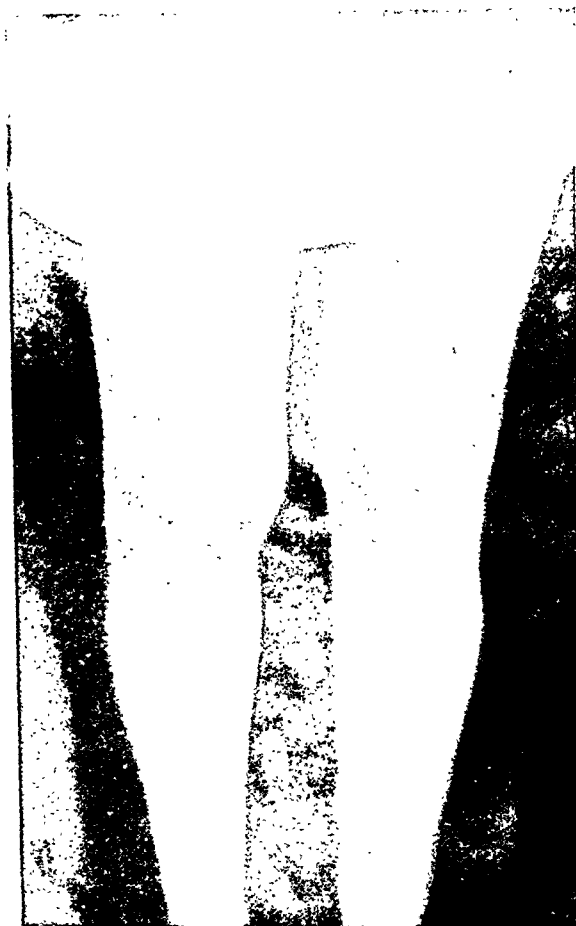


FIG. 5. Anteroposterior view with patient standing.



FIG. 6. Lateral view, revealing power of voluntary extension of the knee.

replaced in its normal location. The tibial tubercle was then freed from its attachment into the tibia and implanted well towards the medial side of the tibia into a channel of bone previously prepared. An incision was then made on the inner side of the capsule of the knee joint and the capsular structures overlapped and sutured, thus plicating the redundant tissues. Following this procedure a rather large opening was left on the outer side of the joint. This was repaired by removing a section of fascia lata from the same thigh and suturing it into the defective area. The wound was closed throughout, using fine chromic catgut sutures, and a plaster of Paris bandage was applied from the toes to the groin, maintaining the knee in approximately 15 degrees of flexion.

and was discharged from the hospital on December 21, getting about with the aid of crutches. She was subsequently observed in the office, where she received physiotherapy, graduated exercises, and was finally discharged from active treatment on February 25, 1930.

Some six months after operation she exhibited a range of motion of from 170 degrees of voluntary extension to 50 degrees of voluntary flexion. The quadriceps muscle, though weak, was sufficiently strong to maintain balance. She was well able to walk up and down stairs without external assistance.

When last observed on June 23, 1936, she stated that she had progressed very favorably and only on rare occasions was it necessary to rebandage the knee to give her some additional support. Examination at this time

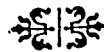
revealed a well functioning knee joint with a range of motion from 175 degrees of extension to 50 degrees of flexion. The patella was freely movable and was situated in its normal location, and the knee was perfectly free from any arthritic manifestations.

It is well recognized that the patella is not essential for normal life when the quadricep tendon is attached through the patella tendon into the tibial tubercle. There are occasional instances recorded in the literature of absence of patellae; the writer has had occasion to examine and treat a child of five years who had no evidence of either patella on clinical or Roentgen ray examination, and whose father had extremely small patellae with very large tibial tubercles. Such individuals get about quite well insofar as the strain of the quadriceps pull is transmitted directly to the tibial tubercle, and not through the patella. The leverage of the extensor apparatus is greatly enhanced by the interposition of the patella. Contraction of the

quadriceps group tightens not only the tendinous insertion and pulls the patella forward, but it also puts tension on the anterior reinforcing apparatus of the knee, and because of this fact becomes a most important stabilizer of the knee in extension. From this point of view the patella serves a very useful function for without it the dynamics of the knee joint is altered and the individual so afflicted has difficulty in performing arduous tasks; in running; in walking up and down stairs. On level surfaces the function is but little interfered with.

The above operation has distinctly improved the dynamics of the knee joint and the patient has now been observed for a period of seven years during which time the patella has remained in its normal position.

This case is recorded as it not only describes a surgical rarity but also presents a reconstructive operation which has withstood a test of several years.



# PELLEGRINI-STIEDA'S DISEASE

## A CASE REPORT

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DETROIT, MICHIGAN

**F**OLLOWING a single or multiple traumatization of connective tissue, muscle or a ligamentous structure, when an area of calcification appears, the condition is known as myositis ossificans. If, however, the tibial collateral ligament is the injured part and the characteristic semilunar calcification appears in it, usually along the superior surface of the medial condyle of the femur, then the condition ceases to be myositis ossificans and becomes Pellegrini-Stieda's disease.

We feel that there is no difference between this and the calcification that occurs in the shoulder muscles of soldiers from the constant trauma of the rifle, "infantry-man's shoulder," the calcifications that occur in the leg muscles of the cavalry-man from the trauma of the saddle against the adductor muscles, "cavalry-man's myositis," and the calcified areas which are seen so often in the gastrocnemius muscles of ballet dancers from the microscopic injuries sustained in these muscles as a result of the constant strain imposed upon them by this dance. Innumerable similar localized areas of calcification can easily be called to mind.

Our case report lends further corroboration to the conception of the American writers, Kulowski,<sup>1</sup> Riebel and Riebel,<sup>2</sup> Oxford,<sup>3</sup> and Wetzler and Elconin,<sup>4</sup> that the process is a metaplasia in this specific connective tissue structure to form bone as a result of trauma. That all connective tissue may respond to trauma in this way is a well recognized fact. The great importance of this specific lesion lies in the fact that the majority of such injuries are sustained at work and become therefore compensation cases. The early recognition of the lesion is most essential for successful

treatment. That a great many such cases are undiagnosed is unquestioned. The general practice is to x-ray the part immediately following the injury. Since in these cases such x-rays show no pathology, the patients complaints two months later, when the calcification occurs, are often attributed to malingering. An x-ray taken at this time, however, shows the characteristic lesion. A failure to take such check-up x-rays might result in a considerable monetary loss to the employer.

Very few cases of this interesting finding are reported in the American literature, although the European literature has many such case reports. This is apt to give one the erroneous impression that the disease, if it can be called such, is rare. Consultation with several of the outstanding industrial surgeons in Detroit disclosed on the other hand, that they regarded this calcification in the tibial collateral ligament described by Pellegrini and Stieda as something so commonly seen following trauma to the knee joint that no importance was attached to it. It is considered the same as myositis ossificans would be elsewhere, and not as a disease entity per se.

In all these reported cases three to four months and sometimes longer elapsed from the time of the injury to the time that the diagnosis was made. In our case report only eight weeks elapsed from the time of the injury until the typical x-ray findings pathognomonic of this disease were found. This is one of the earliest on record. From our x-ray findings it is very likely that the lesion developed two to three weeks previously. This would fix the time of development of the calcification to five weeks following the trauma, at which time it would have been possible to diagnose it by x-ray.

## CASE REPORT

G. T., a colored male, aged 33, was struck a glancing blow upon the left shoulder by the



FIG. 1. X-ray taken four days after injury. Note point A. No injury to medial condyle of femur.

collapse of a plaster wall. He was thrown to the ground, but arose and went about his business, although he complained of some soreness in the left knee joint. He continued being ambulatory for the next four days, but then he called one of us (M. O. C.) because of swelling and pain in the left knee joint which had become progressively worse.

Upon examination at this time (October 5, 1936), the left knee was found to be considerably swollen with a definite area of tenderness over the tibial collateral ligament. There was no hypermobility of the joint. Weight bearing was painless if the leg was not moved as to produce lateral motion at the knee. The maximum point of tenderness was found to be over the superior surface of the medial condyle of the femur. The patella was floating. The findings characteristic of fluid in the knee joint were easily elicited.

The patient was hospitalized and x-rays were taken of the knee joint on the same day. The Roentgen findings disclosed no bony pathology.

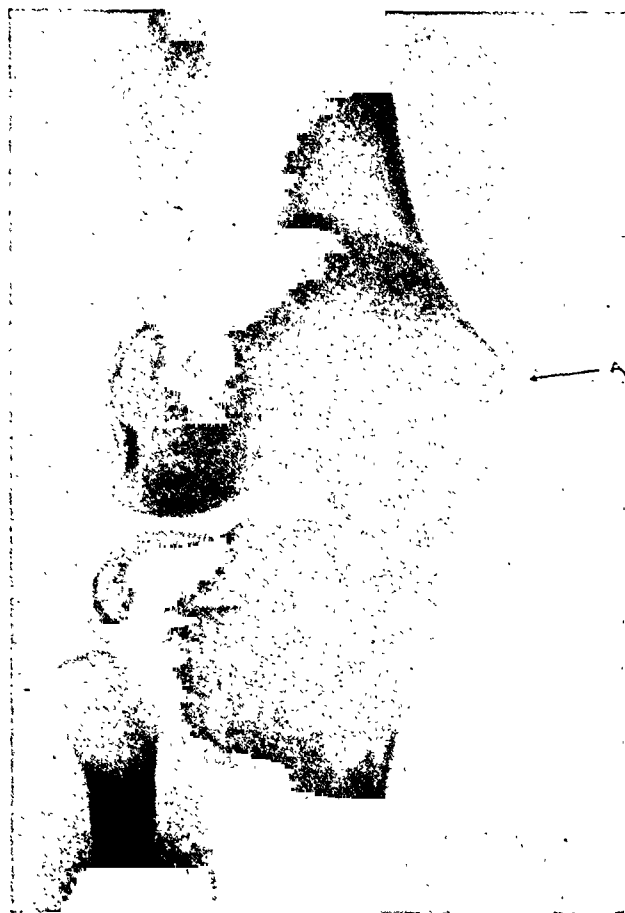


FIG. 2. Eight weeks after injury. Note calcification at A, just medial to superior portion of medial condyle of femur.

(Fig. 1.) Under local anesthesia a long No. 20 caliber needle was inserted into the knee joint and 80 c.c. of dark bloody fluid was aspirated. A wire splint was then applied from the toes to the mid-thigh and a pressure pad and bandage applied to the patella. The patient was discharged from the hospital on October 12, 1936.

*Laboratory Reports.*

Blood: White blood cells 6,700. Polymorphonuclears 77 per cent; lymphocytes 23 per cent.

Urinalysis: Negative.

Kahn: negative.

*Progress Notes.* 10-12-36. No swelling or tenderness over the left knee joint. Motion free. Muscle tone good. Splint replaced.

10-14-36. Small amount of fluid in joint. No tenderness. Motion free. Physiotherapy. Splint replaced.

10-16-36. Thirty c.c. of serosanguinous fluid removed from the knee joint. Motion free.



Slight tenderness over the medial condyle of the femur.

10-23-36. Fifty c.c. of serosanguinous fluid



FIG. 3. Sixteen weeks following the trauma. Note increase in calcification at A. Patient able to work without difficulty.

removed from the knee joint. Plaster cast applied from the toes to the anterior superior spine with the knee flexed 10 degrees and the foot in 5 degrees of plantar extension. The cast was bivalved to permit physiotherapy.

11-6-36. Joint appears normal. No fluid. No tenderness. Motion free.

11-24-36. X-ray examination of the left knee joint revealed the following (Fig. 2): Examination of the left knee by films in the anteroposterior and lateral projections revealed no evidence of fracture, either old or recent. There was some calcium deposited in the soft tissues over the superior portion of the medial condyle of the femur—Pellegrini-Stieda's disease. The knee joint appeared normal, the articular surfaces being smooth, with the joint spacing preserved.

The patient was instructed to come to the office three times a week. At these visits he was given diathermy in the form of short wave (12 m) treatments using 2,500 milliamperes for twenty minutes. The fluid did not recur. Motion at the knee joint became free and painless. The joint was normal to palpation. He returned to work as a laborer and was discharged as cured on January 24, 1937. A check-up x-ray at this time showed that the calcification had increased somewhat in size as can be seen by comparing Figure 3, taken on this date, with Figure 2, taken in November 24, 1936.

#### COMMENT

A case of Pellegrini-Stieda's disease is reported in which the interval from the time of the accident to the formation of the characteristic bony lesion was eight weeks. An x-ray taken immediately following the accident showed no bony injury. This is one of the earliest appearances of the characteristic calcification on record. The knee was immobilized immediately when seen four days after the accident. The immobilization was continued for ten weeks. Even after the complete immobilization the calcification developed. Since the x-rays taken immediately following the accident showed no chip fracture, this case also refutes the earlier conception that this lesion is due to this type of fracture. We feel that the lesion is undoubtedly a metaplasia of connective tissue to form bone and that it ought not to be considered a separate entity from myositis ossificans. The definite space between the calcification and the femur and the outline and shape of the calcification makes the idea of a "fractureless callus" rather far fetched. (Fig. 3.)

Our treatment was conservative, the leg being completely immobilized. The patient returned to work fourteen weeks following the accident. Motion in the joint was free and painless. His only complaint upon discharge was that the joint became sore when the weather changed. Because the cases that were surgically treated by removal of the bony spicule recurred, and because of the excellent results we obtained by con-

servative treatment, we believe that this is the only feasible form of treatment for such cases.

#### SUMMARY

1. Pellegrini-Stieda's disease is merely myositis ossificans which happens to occur in the tibial collateral ligament because of trauma at that point.

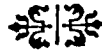
2. Contrary to the impression given by the literature, the condition is quite common.

3. Treatment should be conservative for early return to work.

4. The presence of the calcification does not in itself constitute a disability, but should be considered as any other asymptomatic foreign body.

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THE sequence of events in bone necrosis appears to be: (1) septic embolism which cuts off the blood supply of a definite bone segment (infarct), and (2) subsequent invasion and infection of the infarcted area by bacteria from the embolus.

From—"Pediatric Surgery" by Edward C. Brenner (Lea & Febiger).

# ACUTE INTESTINAL OBSTRUCTION COMPLICATING THYROTOXICOSIS\*

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**A**CUTE intestinal obstruction occurring in an individual already suffering from a severe hyperthyroidism presents a complicated surgical problem.

## CASE REPORT

The patient, Mrs. V. L. L., age 24, white, mother of two children ages nine and seven years, was first seen at my office on January 7, 1937. She presented the clinical picture of severe hyperthyroidism: great muscular weakness, physical and mental restlessness, tremor, palpitation, tachycardia, flushing, sweating, loss of weight, blood pressure 160 systolic, 90 diastolic, prominence of eyes, with von Graefe's and Stellwag's signs positive. There was bronzing of the skin, a metabolic rate of plus 38, a cardiac murmur, but no fibrillation. The blood Wassermann was negative.

*Past History.* Appendectomy had been done ten years previous, tonsillectomy eight years previous, bilateral oöphorectomy, salpingectomy and supracervical amputation of the uterus five years previous when the patient was 19 years old. Following her surgical castration she had a severe menopausal syndrome, and also chronic obstruction of the bowels resulting from pelvic adhesions. She had several attacks of severe obstipation.

It was planned to send her to the hospital the first of the following week and start preoperative treatment for her hyperthyroidism. The day after her examination, about 6 P.M., she was seized with sudden cramp-like pains, described as being all over the abdomen, constant and severe in type. She vomited shortly after the onset and several times through the night. Two or three bowel movements occurred soon after the pain started, but none later. There was considerable rumbling in the bowels. The above history was given me the following morning when I was called.

Upon examining her I found tenderness across the lower abdomen, moderate distention, visible and audible peristalsis, pulse rate 180, marked palpitation, respirations rapid and shallow. The patient was in great pain and extremely nervous. The vomitus was not fecal in character. A diagnosis was made of acute intestinal obstruction complicating hyperthyroidism.

The patient was sent to the hospital and it was decided to operate immediately to relieve the obstruction. The usual preanesthesia medication had very little effect. Preoperative gastric lavage was not done. She was operated on at 2 P.M., twenty hours from the onset of the obstruction.

*Operation.* On January 9, under spinal anesthesia, an adequate incision was made. When the peritoneum was opened, approximately a pint of clear fluid escaped. The coils of the small bowel were distended and discolored. A quick exploration revealed the obstructive mass in the lower right quadrant. Several coils of bowel were fastened together with string adhesions; these were clipped one at a time and two or three loops of bowel were thus released. The obstruction was in the terminal ileum about 11 inches from its entrance into the cecum. This kink was found firmly attached to the pelvic floor and what was left of the right broad ligament by adhesions resulting from the previous surgery. Above the obstruction the bowel was distended; below, it was ribbon-like and flat and the colon was empty. The adhesions were separated and the kinked loop was delivered into the abdominal wound. The adhesions holding the kink together were cut and the bowel straightened out. Fecal material and gas readily passed through the previous point of obstruction into the empty bowel below. This kink of bowel, when released from its adhesions, presented a raw area approximately 10 X 4 cm., covered with granulating

\* Presented at Staff meeting, Hospital of the Good Samaritan, February 8, 1937.

tissue. A free omental graft was sutured over this denuded area.

An enterostomy of the Witzel type was done.

The patient was placed in an oxygen tent and carbogen inhalations were given every two hours. A suction apparatus was used to clear

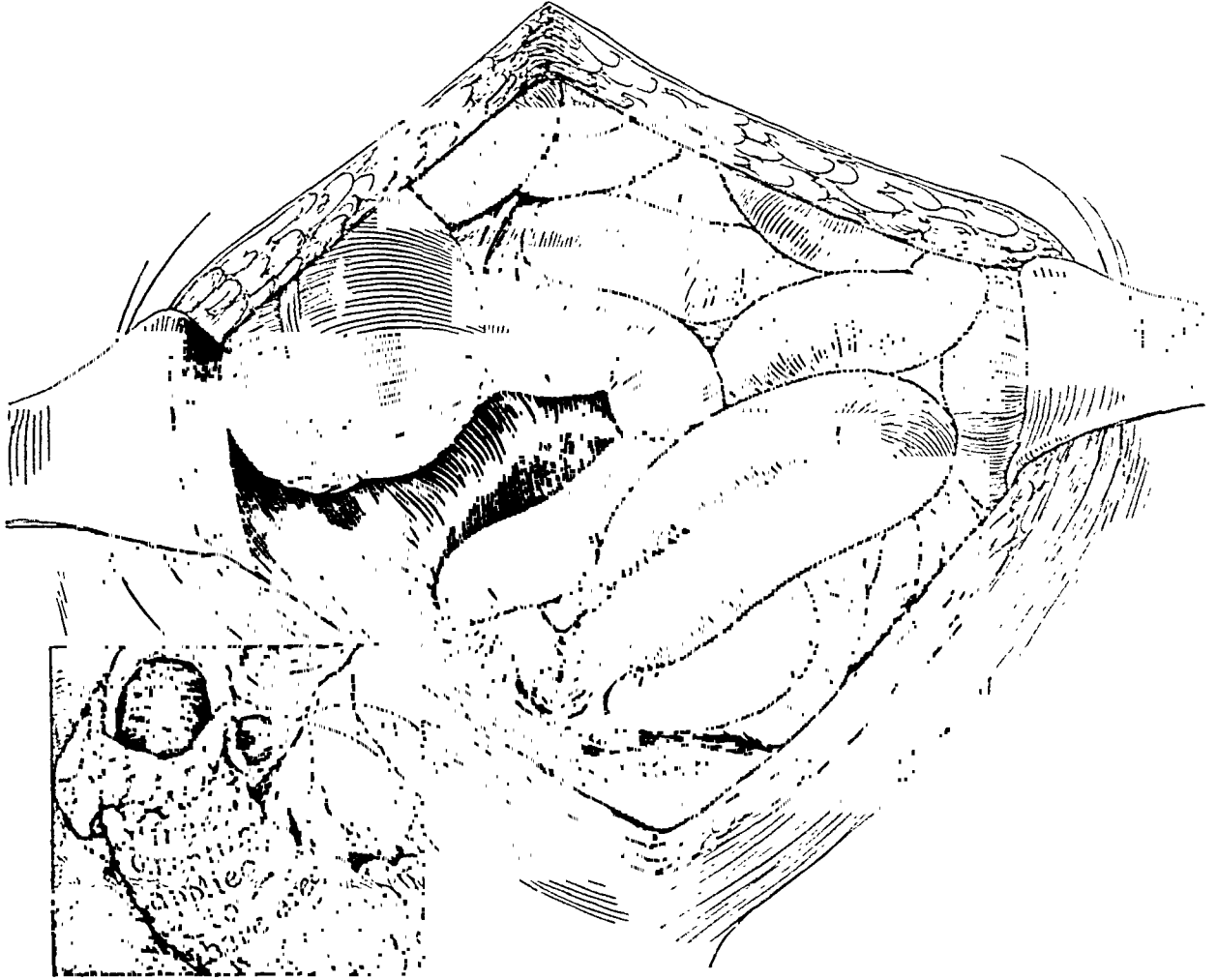


FIG. 1. Adhesions and obstruction in the terminal ileum. Insert: Free omental graft sutured over denuded area of bowel.

The catheter was anchored to the skin with silkworm-gut sutures. The abdomen was closed without other drainage.

*Postoperative Treatment.* Continuous subcutaneous and intravenous fluids were administered. Fifty minims of Lugol's solution were ordered daily. The enterostomy tube was connected to the Connell siphon apparatus; gas and material passed through the tube rapidly and drainage was most satisfactory. The next morning the patient had developed a thyroid crisis. She was irrational; her exophthalmos had increased markedly; the eyes remained open wide even in sleep, and the sclera and cornea became red and irritated; corneal ulceration occurred later. Temperature was  $104^{\circ}\text{F}$ ., pulse rate about 180; there was a copious accumulation of mucus in the trachea. This whipped back and forth with the rapid respirations.

the throat of mucus. Intravenous injections of sodium iodide, gr. 15 were given daily instead of Lugol's solution; ice bags were applied to head, throat and heart; subcutaneous and intravenous fluids were continued. The fluid intake the first twenty-four hours after the operation totaled 6,000 c.c.—4,000 c.c. of sodium chloride solution by hypodermoclysis and 2,000 c.c. of 5 per cent glucose solution intravenously. Similar amounts were given for the next four days.

On the fifth postoperative day the patient developed a generalized edema. Subcutaneous and intravenous fluids were discontinued and fluids were given by mouth only, 2,900 c.c. on the fifth day and an adequate amount from then on daily. The edema soon subsided.

The patient was removed from the oxygen tent after seven days (January 17). The carbo-

gen inhalations were continued for two more days. Her thyrotoxicosis was under control on the eleventh postoperative day (January 20),

an adequate subtotal bilateral thyroidectomy was done.

*Thyroidectomy.* Under gas oxygen anes-

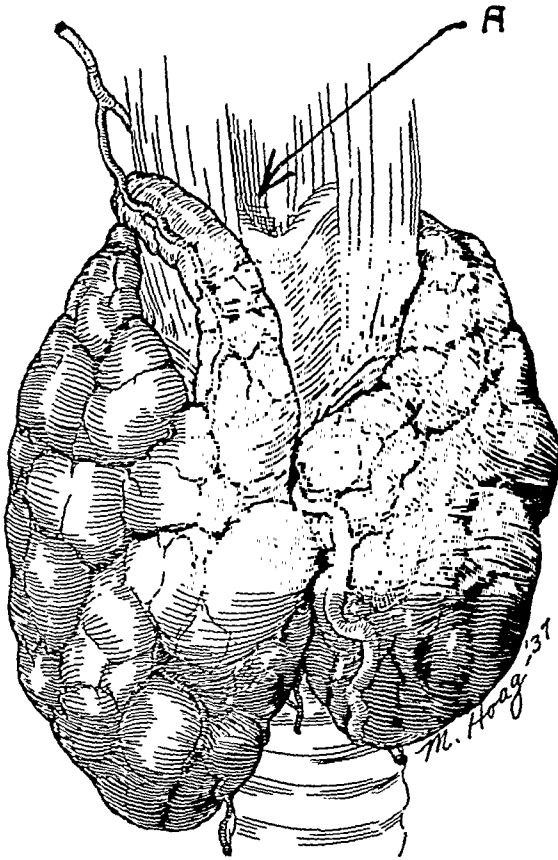


FIG. 2. Drawing of thyroid showing (a) large pyramidal lobe.

the pulse was 100, respirations 22, temperature normal. The enterostomy tube had drained well until this day, when it was removed. There was no subsequent drainage from the stab wound and no leakage around the tube while it was in place; the surrounding skin was not irritated.

For the next four days the patient remained about the same. On January 25, or the sixteenth postoperative day, she became more restless, hysterical at times, with a temperature of 102°F., a pulse of 140, and respirations 32. The pulse came down a little the following day but was still rapid; it was thought that she was getting out of iodine control. On January 27, or the eighteenth postoperative day the temperature was 103°F., pulse 140, respirations 28. On January 28, the temperature suddenly dropped to normal and pulse to 80. She remained in good condition January 29, and on the following day, the twenty-first after the bowel operation, she was taken to surgery and

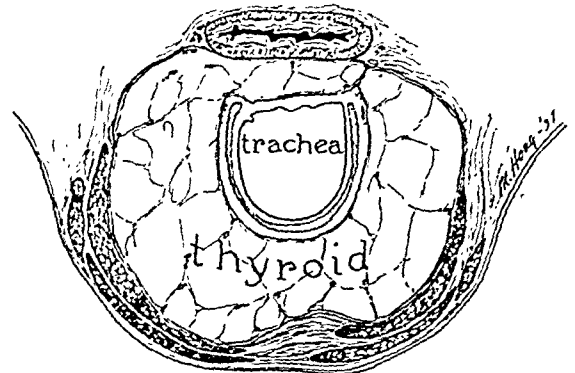


FIG. 3. Transverse section of thyroid showing superior pole right lobe in back of trachea and tracheal compression.

thesia the thyroid gland was exposed in the usual manner. A large pyramidal lobe was found situated to the right of the midline attached to the fascia covering the thyroid cartilage. Its base was connected with the isthmus and the apex extended up to the top on the right side of the thyroid cartilage. There was a good sized branch of the superior thyroid artery at its tip. The right upper pole extended around behind the trachea to its left side with resultant compression of the trachea.

Probably due to her recent severe tracheitis, the upper right superior pole was adherent to the trachea and esophagus. The thyroid tissue in the pole behind the trachea was about one-half inch thick. In order to visualize the tip and the superior thyroid vessels, it was necessary to displace the trachea to the left, and with a forcep on the upper end of the right lobe, make countertraction. By blunt dissection this pole was exposed so that the vessels could be doubly ligated and cut.

The internal capsule was adherent to the right lobe. However, a line of cleavage was found and the lateral and posterior aspect of the thyroid exposed. The inferior thyroid artery was visualized, the anterior branch ligated, and the inferior veins were ligated. There was an unusually large middle thyroid vein on the anterior surface of the isthmus running down to the left side of the trachea. The isthmus was separated from the trachea by blunt dissection, clamped and cut. The right lobe was resected, leaving a small piece of thyroid tissue about  $2 \times 2 \times 4$  cm.

The patient being in fair condition, the left lobe was resected leaving a small piece of tissue approximating that which was left on the right side.

associated with mechanical or functional obstruction, it has a very definite favorable benefit in aiding the elimination of gas from the intestinal lumen. Oschner<sup>2</sup> in a

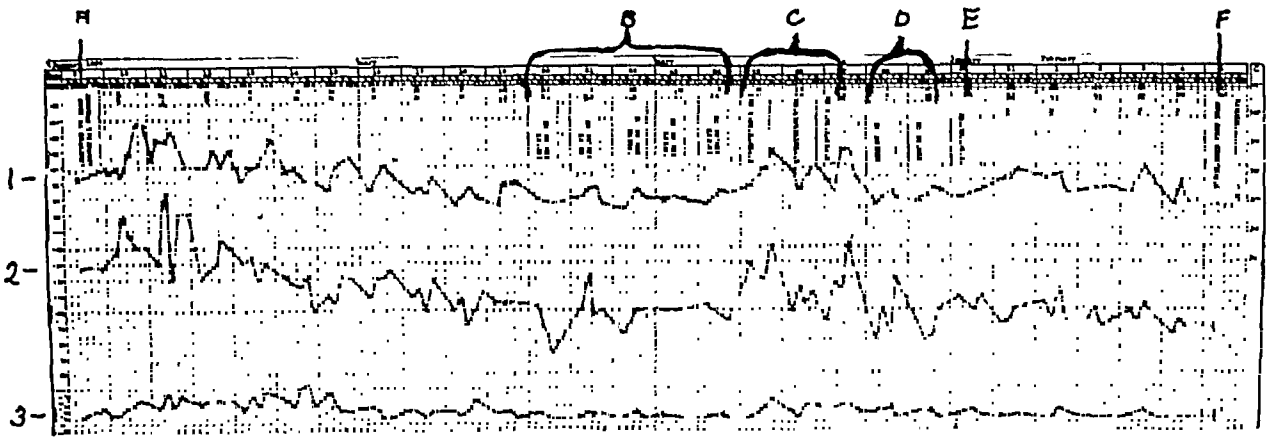


FIG. 4. Temperature chart showing: (1) temperature, (2) pulse, (3) respiration; a, admission to hospital and abdominal operation; b, remission the thirteenth, fourteenth, and fifteenth day of iodine administration; c, hyperthyroid symptoms sixteenth, seventeenth, and eighteenth day; d, nineteenth and twentieth day remission; e, thyroidectomy; f, discharged from hospital.

When the patient was returned to her room following thyroidectomy, she was immediately placed in the oxygen tent and given carbogen inhalations every two hours; continuous subcutaneous and intravenous fluids, sodium iodide intravenously, ice bags to head, throat and heart were continued and pantopon and nembutal were given in sufficient amounts to keep her drowsy. The total fluid intake the first twenty-four hours was 8,000 c.c.—5 000 c.c. of sodium chloride solution subcutaneously and 3,000 c.c. of 5 per cent glucose in sodium chloride solution intravenously. The second postoperative day she was removed from the oxygen tent, and additional fluids were given.

On the third postoperative day the skin clips were removed and she was allowed to sit up in a chair. The fourth and fifth days were uneventful; the wound was healed, dressings discontinued and the patient was up and about in good condition. There was no unfavorable reaction.

#### COMMENTS

1. The use of oxygen seemed well indicated. It not only dealt with the anoxemia associated with hyperthyroidism and tracheal compression, but also tended to overcome the anoxemia resulting from the use of morphine and the distention in the bowel. Dr. Fine<sup>1</sup> of Boston believes that if oxygen is administered for the distention

recent article agrees with Fine, and adds that part of the anoxemia associated with intestinal obstruction is probably due to the morphine usually administered.

2. The enormous amount of mucus that accumulated in the trachea was very uncomfortable and disturbing to the respiratory function. The mechanical suction apparatus with a catheter attached which was used to aspirate the mucus from the trachea was very satisfactory and gave immediate relief. The tracheal compression was increased by the swelling in the superior pole during the thyroid crisis. The patient was able to guide the catheter herself and the aspiration was repeated as frequently as the mucus accumulated.

3. The temperature chart shows that the peak of the remission occurred on the thirteenth day and remained there the fourteenth and fifteenth day. On the sixteenth day there was an exacerbation of the symptoms, suggesting that the patient was getting out of iodine control. However, by continuing with the iodine administration and other measures, remission was again obtained on the nineteenth day. This was maintained through the twentieth day and thyroidectomy was done on the twenty-first day.

4. Lahey<sup>3</sup> suggests that if a patient suffering with hyperthyroidism is operated upon within three weeks of a thyroid crisis one is rarely justified in performing a bilateral subtotal thyroidectomy in one stage. He recommends that the right lobe and the isthmus be resected in one stage and about six weeks later, the left lobe. In the case reported here it was felt that it would add very little additional risk to do a one-stage operation. Most of the pathology was in the right lobe and isthmus; the

left lobe was small and its resection was quite simple.

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CONTINUED external biliary fistula is always marked by a profound progressive anemia, diminution of hemoglobin and red blood cells.

From—"Bile—Its Toxicity and Relation to Disease" by O. H. Horrall (University of Chicago).

# NEW INSTRUMENTS

## SUCTION APPARATUS\*

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NEW YORK CITY

THE value of suction as a therapeutic procedure in surgery, has been definitely established. The great contribution of Wangensteen<sup>1</sup> in the use of suction in the relief of intestinal distention is a noteworthy example. The other surgical conditions in which suction can be employed are: stomach drainage, duodenal drainage, biliary drainage, and suprapubic drainage.

All of the apparatus used since 1917 for slow suction in surgical conditions have been vacuums produced by water siphons. Mechling,<sup>2</sup> in 1917, described the earliest suction apparatus. The apparatus consisted of tanks revolvably supported on a frame and arranged one above the other with a means of permitting the fluid of one tank to pass to the other tank to cause a vacuum in one of the tanks. Felsen,<sup>3</sup> in 1918, described a suction apparatus for thoracentesis. The apparatus consisted of a hermetically closable liquid reservoir, adapted to contain a partial filling of liquid and an air space above the level of the fluid. A vent in the bottom of the bottle permitted gravity drainage of the bottle with resulting suction produced in the air space above. Tuttle,<sup>4</sup> in 1919, patented an apparatus which used the same principle as that of Felsen, but was larger and more complicated in its detailed mechanism. Bethune,<sup>5</sup> in 1921, patented a reversible double container vacuum pump so connected that, when fluid passed from the upper to the lower container, a vacuum was produced above the level of the liquid in

the upper container. Gaynor and Wheelwright,<sup>6</sup> in 1935, reinvented the apparatus described by Bethune, adding a more elaborate valve mechanism. Wangensteen earlier described his simple water siphon suction device.

One of the principal objects of the present apparatus is to provide an improved vacuum siphon apparatus, wherein air, rather than water, is employed for the purpose of producing the relatively low vacuum, which is necessary to provide a proper order of drainage.

Another object is to suggest an improved suction apparatus which is small in size and readily movable, light in weight and easily operated. The device will function for a considerable period of time without any attention on the part of the operator, and is readily controllable as to the amount of fluid which is drawn from the body.

The suction device comprises a collection bottle of suitable size, the bottle having a pair of flexible ducts leading therefrom, one of such ducts leading to the patient and the other to a somewhat larger bottle, preferably spherical in shape and containing an inflatable bag. A tube leads into the bag, the opposite end of the tube having means for connection with a conventional air pump. The tube also has a plurality of valves or petcocks in the line of flow of fluid passing through it. One of the petcocks is of conventional form and the other is formed with an aperture in the valve, so that a slight flow of fluid may take place even when it is closed. This

\* From New York University College of Medicine and Third Surgical Division Bellevue Hospital, Arthur M. Wright, M.D., Director.



aperture should be large enough to permit about 30 c.c. of air to pass through per minute.

naturally ceases, due to the equalization of pressures. If the duct from the collection bottle is to be left in the patient afterward,

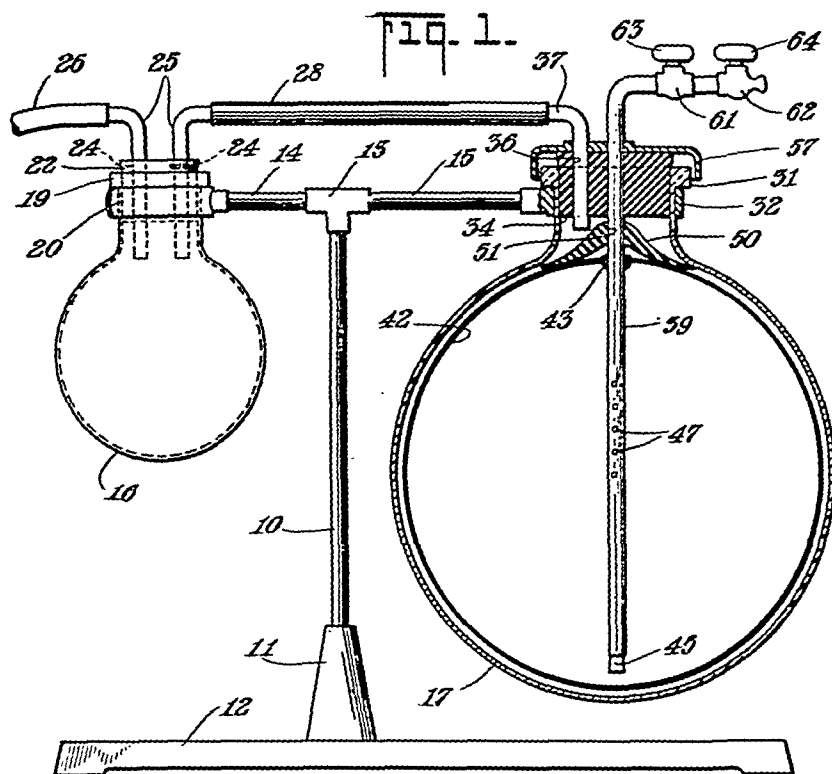


FIG. 1. A side elevation of the device, partially in section.

The bag (Fig. 2) is inflated by a conventional pump to a point where it more or less completely fills the spherical vessel, after which both valves are closed. When the device (Fig. 3) is to be used, the first mentioned valve is opened, thereby permitting 30 c.c. of air to pass out of the bag per minute. In so doing, a partial vacuum is created in the larger vessel which is connected to the collection bottle by a flexible duct. Within three or four minutes, the air in the collection bottle is withdrawn to a point wherein the suction becomes effective and fluid is withdrawn from the patient.

The suction continues as long as there is fluid in the cavity of the patient, or as long as there is air in the cavity at a pressure in excess of atmospheric pressure. When the air in excess of atmospheric pressure, and the fluid have been withdrawn from the cavity, the suction quite

no further air will pass from the inflated bag until the suction again begins to function.

The device (Fig. 1) is mounted on a vertical support (10), which is made from tubing of suitable diameter to provide the desired strength, in a socket (11) at its lower end, the socket in turn being secured to an elongated substantially rectangular base (12). A "T" fitting (13) is mounted at the upper end of the vertical support (10). The "T" carries horizontal tubular members 14 and 15, the tube (14) supporting the relatively smaller collection bottle (16), and the tubing (15) supporting the larger, spherical, vacuum-producing bottle (17).

The upper end of the collection bottle is formed with the usual flange (19) which is supported by a substantially U-shaped collar (20) carried by the tube (14). A stopper (22), made of rubber or other

suitable material, is placed in the upper end of the collection bottle; the stopper is formed with a pair of spaced longitudinal

flange (31) at its upper end which rests upon a circular collar (32) carried by the horizontal tube (15).

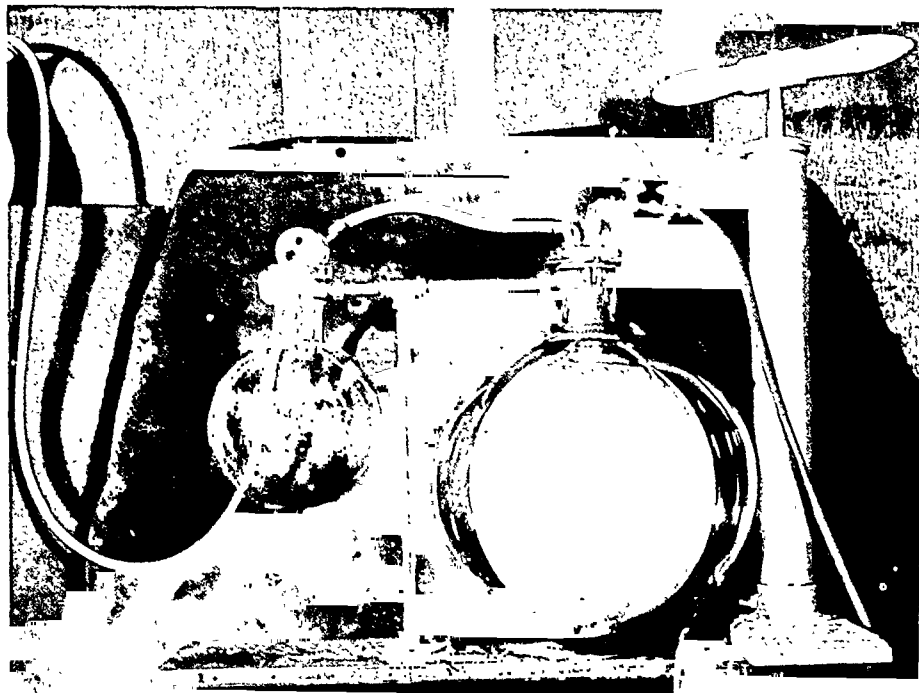


FIG. 2. Bag being inflated, stopper disconnected in collection bottle.

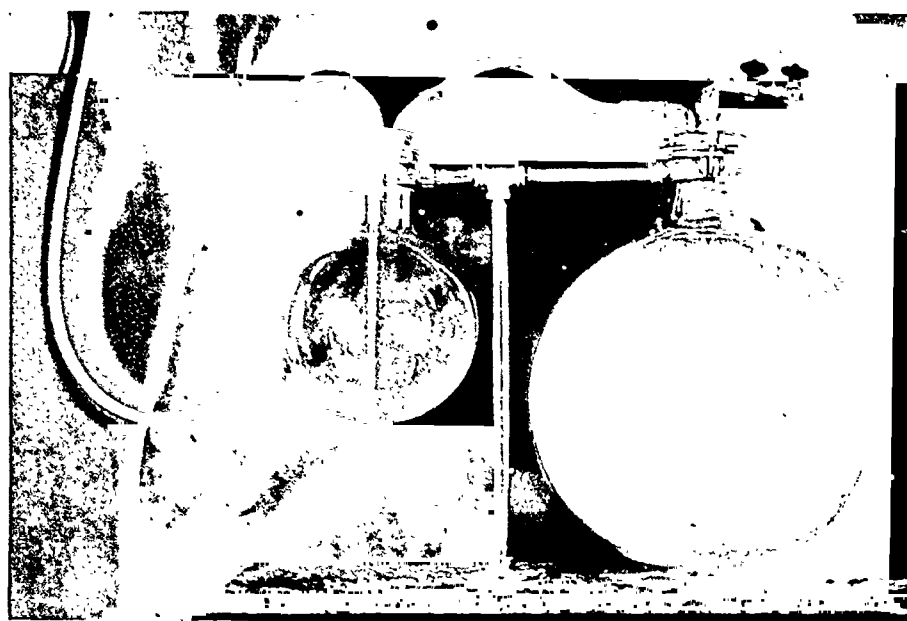


FIG. 3. Stopper in collection bottle replaced. Petcocks open, air escaping from bag to produce vacuum.

apertures (24), which contain inlet tubes (25). To one of these tubes is secured a length of rubber tubing (26) which passes to the patient; the other tube carries a shorter length of rubber tubing (28) which passes to the vacuum-producing bottle (17). This bottle is likewise provided with a

A rubber stopper (34) within the opening of the bottle (17) is provided with a pair of spaced apertures (36). In one of these there is a short inlet tube (37) connected with the rubber tube (28) and extending into the bottle (17) only a short distance below the stopper (34). The second

aperture in the stopper holds a somewhat longer tube (39) which extends downward to a point adjacent to the lower end of the bottle.

An inflatable rubber bag (42), having a reinforced opening (43), is mounted on the tube, the tube passing through it in such a way that an air-tight seal is formed. The bag is of such size, that when inflated it completely fills the spherical bottle (17) in which it is contained. In order to prevent injury to the bag, a suitable stopper (45) is placed in the aperture at the lower end of the tube. The tube also has several spaced apertures (47) in its side walls, so that air may pass from the tube into the bag.

Just above the bag there is an annular gasket (50) with a central aperture (51) through which the tube (39) passes. The gasket is of slightly greater diameter than the diameter of the neck of the bottle in order to prevent the inflated bag from coming in contact with the lower end of the tube (37). The collar (32) which supports the bottle (17) is provided with upward extending bolts (54) on opposite sides, and the bolts are provided with wing nuts (55). There is a metal cap (57) with a pair of spaced ears (58) on opposite sides at the upper end of the bottle above the stopper (34). The screws (54) pass between these spaced ears; the cap (57) is held in firm engagement with the upper end of the bottle by means of the wing nuts (55). The upper end of the tube (39) carries a pair of petcocks (61) and (62), provided with valve handles (63) and (64). One petcock (62) is of the conventional type and the other (61) is provided with a valve (not shown) which, when closed, permits a

small quantity of air, about 30 c.c. to pass through per minute.

To inflate the bag, the petcocks are opened and a conventional pump with check-valve (not shown) is attached to the nipple (65) on the valve (62). When the bag is completely inflated, the valves are closed, the pump removed, and the device is ready for use.

In use, the flexible tube is first connected with the patient and the valve in the petcock 62 opened, thereby permitting approximately 30 c.c. of air to pass out of the bag per minute. In four minutes or thereabouts, a sufficient quantity of the air is withdrawn from the collection bottle (16), to cause the suction apparatus to become effective and start the withdrawal of fluid from the patient.

When the fluid in the patient's cavity has for the time being become exhausted, or when the air pressure within the cavity has been reduced to atmospheric pressure, the suction ceases by the equalization of the pressures within and without the device. It is not necessary, however, to shut the valve (62) at this time, since suction again begins to function as soon as more fluid has collected in the cavity.

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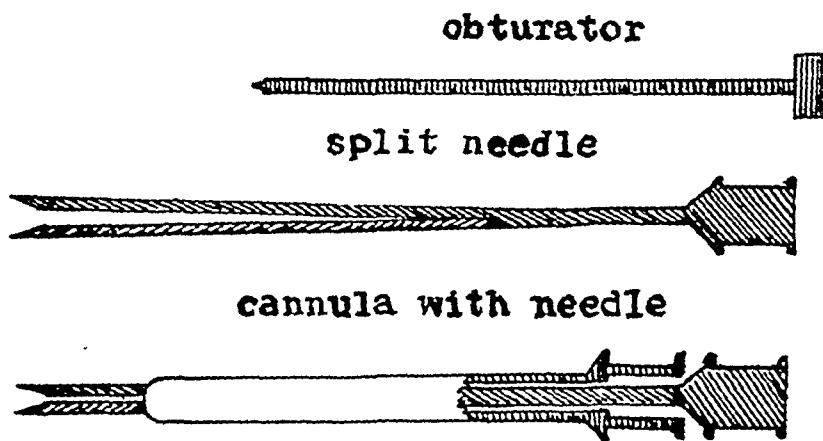


# A NEW BIOPSY NEEDLE

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**T**ODAY so much emphasis is being placed on the early diagnosis of cancer that the utmost importance is at- extremely variable, and for this reason many modifications have been devised to insure the extraction of tissue. These con-



## A NEW BIOPSY NEEDLE

FIG. 1.

tached to biopsy instruments designed to yield the maximum amount of tissue with a minimum amount of trauma. Hitherto the

sist of wires or metallic devices with corkscrew tips, barbs, or dental burrs, fused to the ends, and introduced into the lumen of

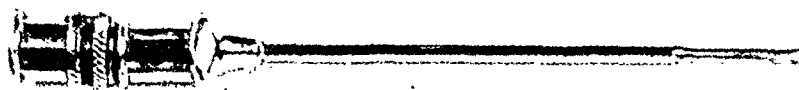


FIG. 2.

aspiration biopsy has been considered the simplest and least traumatizing method and has been used in many cancer clinics throughout the country. The practical value of a positive biopsy has greatly outweighed any theoretical objections to its use. Briefly, the method consists of inserting a needle of about 17 gauge into a suspected tumor, aspirating the material and then spreading it out between two glass slides. In these smears enough tumor cells may be found to make a correct diagnosis possible. Unfortunately, the percentage of positive smears has proved to be the aspirating needle. Somewhat larger instruments were devised by Muir, Hoffman, Lindblom, and Corriero.

The biopsy needle which is now presented was devised in the tumor clinic of the Caledonian Hospital on the service of Dr. Joseph Tenopyr. It is believed to be superior to all others heretofore used for the same purpose because it causes as little trauma as a simple aspiration biopsy, takes only a few moments to do, and yields a larger piece of tissue in proportion to its size. With a 16 gauge needle a piece of tissue 2 by 10 mm. is obtained. A single punc-

ture is sufficient to obtain tissue, and repeated insertion of the needle is not necessary.

The instrument consists of an outer needle or cannula of 16 gauge, and an inner needle of 18 gauge which is split longitudinally down to the hub. To obtain a specimen, the skin over the suspected mass is prepared with tincture of iodine and alcohol, and then 1 c.c. of a solution of  $\frac{1}{2}$  per cent procaine hydrochloride is injected intradermally and subcutaneously over the site of puncture. The outer needle or cannula, with obturator in place, is in-

serted into the tissue up to the suspected tumor. The obturator is then removed and the split needle inserted in its place and pushed into the tumor mass cutting a cylinder of tissue between its prongs. The outer needle or cannula is now advanced over the split needle into the tumor for a distance of about  $\frac{1}{2}$  inch. The entire instrument is then rotated slightly, after which the inner needle is withdrawn with the specimen. The latter is then placed in 10 per cent formalin and prepared for cutting in paraffin and staining in the usual manner.



IN the absence of bacteriemia [in acute hematogenous osteomyelitis] and in the average case accompanied by mild infection, operation is contraindicated *unless suppuration develops*: within the bone, beneath the periosteum, or in the soft parts.

From—"Pediatric Surgery" by Edward C. Brenner (Lea & Febiger).



[From Fernelius' *Universa Medicina*, Geneva, 1679.]

# BOOKSHELF BROWSING

## PREDISPOSITION TO CANCER IN THE BONAPARTE FAMILY

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VERY few are aware of the fact that throughout his life Napoleon Bonaparte was obsessed by secret fear of the "familial disease." While he refrained, almost to the point of superstition, from discussing this subject, yet certain phrases dropped here and there, and duly recorded by witnesses, permit us to believe that from the day he learned of his father's death, the thought that he might fall heir to the same disease never left him.

In 1806, when he suffered a mild attack of gastralgia, he remarked to Count Lobau that he "bore in himself the germ of a premature death."<sup>1</sup> Evidently as time went on he became even more seriously concerned. In 1811, he ordered that a copy of his father's autopsy report be obtained and then studied it carefully. Shortly afterwards, he suddenly manifested an interest in anatomy and even began to take lessons from his court physician, Dr. Corvisart, although in absolute secrecy. Instruction was illustrated by portions of cadavers brought into the palace wrapped in towels. Dr. Corvisart recalls that the human stomach was an object of Napoleon's special interest, but the lessons were soon discontinued, as the Emperor could not bear the sight of dead flesh. His knowledge of anatomy apparently did not progress to

any extent, for years later while an exile on St. Helena and seriously ill, he once more questioned his attending physician, Dr. Arnott, at great length on the anatomy of the human stomach. On hearing the term "pylorus," he asserted quite gravely that there lay the seat of his illness and added "I am dying from the same disease as my father."<sup>2</sup> In delirium and near death, he kept repeating "Pylorus . . . my father's pylorus."<sup>3</sup>

Some of his brothers and sisters, as well, lived under the hypnosis of the same idea—that they were doomed to die from cancer.

The Bonapartes' predisposition to cancer has been referred to more than once by Napoleon's biographers. However, this question has never been fully discussed in medical journals. One of the most noted of Napoleon's biographers, Frederic Masson, remarked in this connection:

"The Bonapartes had no hereditary flaw. They appear to have been disposed, more than others, to an illness which is claimed not to be hereditary—cancer. Several of them succumbed to it, but the majority escaped. Four cases out of nearly forty do not constitute a family flaw."<sup>4</sup>

However, it would undoubtedly constitute a predisposition to cancer if four members of the family died from this

disease. In the present paper, the case histories of some of the Bonapartes are briefly summarized, based on available medical records, and the predisposition of the Bonapartes to cancer is analyzed in the light of our present-day medical knowledge.

#### CASE HISTORY: CHARLES BONAPARTE, NAPOLEON'S FATHER

Little is known of Charles Bonaparte's parents, except that his father died at the age of 40 from stomach disease. There is some indication of cancer. No information is available concerning his mother.

The first symptoms of gastric dysfunction became evident in 1783 when Charles Bonaparte was 37. He complained of frequent vomiting, loss of weight and pain in the epigastric region. In November 1784, he consulted Dr. Tournatoire at Aix, whose diagnosis was advanced carcinoma of the stomach. Bonaparte left for Montpellier, where he was treated by Drs. Farjon and Lamure, who agreed that he was suffering from a large tumor in the pyloric portion of the stomach.<sup>5</sup> He died February 24, 1785, at the age of 39. An autopsy was performed at the Montpellier Medical School by Dr. Bousquet, Surgeon-in-Chief, assisted by Dr. Fabre, an intern in the Department of Surgery. The post-mortem findings were as follows:

"The stomach was found to be distended and filled with the liquid that the patient has ingested; the inferior orifice of the organ formed a tumor of semicartilaginous consistency, which was of the shape and size of a large potato or a large elongated pear. The lining of the stomach towards its greater curvature was very much thickened and of hard consistency, like that of cartilage; the thickness of the lining was increased nearing the pylorus, and the inferior orifice of the stomach was enclosed in the center of the tumor, and was found to be so contracted that one had to use a scalpel in order to introduce the tip of the finger; this tumor did not extend beyond the pylorus. The duodenum was in its natural state. The liver was found to be partially congested and the gall-bladder, completely filled with very dark bile, had acquired the volume of a medium

sized elongated pear. Although the pancreas seemed very sound, granules of a larger size than is natural were easily perceived."<sup>6</sup>

Although a microscopic examination was not made, there is little doubt that Charles Bonaparte, father of Napoleon, died of carcinoma, the tumor being of a scirrhus type. The post-mortem diagnosis confirmed the one made by his physician a year before his death.

#### CASE HISTORY: NAPOLEON BONAPARTE

His father died from cancer of the stomach at the age of 39. There is indication that his grandfather, Joseph Bonaparte, also suffered from the same disease. His mother, Letizia, died of pneumonia at 70. As a child, Napoleon suffered from jaundice and intestinal disturbance. At the age of 18, he had an attack of malarial fever (Dr. Bienvelot). At the age of 23, he contracted a scabious skin infection (Sarcopes), from which he continued to suffer for more than eight years. Gradually, chronic eczema developed. At the age of 25, he experienced a grave intestinal infection (Dr. Desgenettes). From that time on, he complained of chronic constipation and hemorrhoids. He had a temporary attack of jaundice (acholuric icterus). From about 28 to 30, he suffered from a persistent cough accompanied by fever; on one occasion, hemoptysis of pulmonary origin was manifested (Dr. Corvisart). About that time, he began to suffer from dysuria, due to non-gonococcic urethritis (Dr. Boyer, Dr. Ivan).

After 30, gastric symptoms gradually increased in frequency, indicating the presence of chronic gastritis. There was persistent constipation. At the age of 47, at St. Helena, a scorbutic condition developed, accompanied by tonsillitis, hypoglossitis and swelling of the gums (Dr. O'Meara). In July 1817, at the age of 48, he had an attack of bronchial catarrh. In September 1817, he suffered from edema of the feet, nausea, a dull sensation in the right hypochondriac area and numbness in

the right scapular region. The diagnosis of Drs. O'Meara and Stokoe was acute hepatitis. The symptoms of dyspepsia increased—nausea, flatulence, vomiting. There was no pain in the gastric region, however, but a dull sensation still persisted in the right hypochondriac area. Anorexia and melancholy were pronounced.

In 1819, there was marked anemia accompanied by accentuated jaundice. A diagnosis of chronic hepatitis was made by Dr. Antommarchi. In July 1820, fever, bilious vomiting and persistent diarrhea began. On August 17, 1820, he complained for the first time of a knife-like pain in the right hypochondrium and hypochrosis and acroparasthesia were observed. From then on, his condition gradually grew worse. His stomach rejected all food; he was confined to bed. Yet, his physicians were still optimistic. Dr. Antommarchi's diagnosis in March 1821 was "gastrica pituitosa fever" (acute gastritis). On April 2, 1821, Dr. Arnott diagnosed the case as gastritis, hypochondriasis and secondary anemia. The consultation of Drs. Shortt, Mitchell, Arnott and Antommarchi resulted in no definite diagnosis. On April 23, the diagnosis of dyspepsia and hypochondriasis was upheld by Dr. Arnott. For the first time, on April 25, the presence of gastric ulceration was suggested by Arnott. Constant vomiting, fever, and delirium were present. Napoleon died at 5:49 on the afternoon of May 5, 1821.<sup>7</sup> On May 6, an autopsy was performed by Drs. Shortt, Mitchell, Livingstone, Arnott, Rutledge, Henry and Antommarchi.

*Autopsy Findings.* "On the anterior surface of the stomach, near the small curve, at a distance of about three fingers from the pylorus, there was a slight obstruction, apparently of a scirrhus nature, and distinctly circumscribed. The stomach wall was perforated through and through and in the center of that small induration, the aperture of which was closed by adhesion of that part to the left lobe of the liver.

"On opening the stomach along its greater curvature, it was observed that the mucous

membrane of the stomach was sound from the lesser to the greater cavity, following the greater curvature. Almost the whole of the remainder of the internal surface of the stomach was occupied by a cancerous ulcer, the center of which was in the upper portion along the lesser curvature of the stomach, while the irregular digital and linguiform border of its circumference extended both before and behind that internal surface and from the orifice of the cardia, to within a good inch of the pylorus. Its rounded opening scarcely occupied a diameter of four or five lines inside and at the most, two and a half lines outside. The circular border of that opening was extremely thin, slightly denticulated, blackish and formed only by the peritoneal membrane of the stomach. An ulcerous, grayish and smooth surface lined this canal, which, but for the adhesion of the liver, would have established a communication between the cavity of the stomach and that of the abdomen. The right extremity of the stomach, at a distance of one inch from the pylorus, was surrounded by a tumor, or rather a scirrhus annular induration, a few lines in width. The orifice of the pylorus was in a perfect condition. The lips of the ulcer exhibited a remarkable fungus-like swelling, the bases of which were hard, thick and in a scirrhus state."<sup>1</sup>

The physicians present at the autopsy all agreed that it was cancer in the pyloric region of the stomach that caused Napoleon's death.

However, no microscopic examination has ever been made, since the stomach tissue was not preserved. Therefore, at best, a diagnosis can be only speculative, based on the macroscopic description. It may have been either adenocarcinoma of the stomach or a benign callous ulcer of long duration. But the clinical records and the physicians' daily reports strongly suggest a malignancy of the stomach. The absence of gastrorrhagia and postprandial pain during the three years' course of the disease do not support the hypothesis of the presence of a benign ulcer of long duration, which may have gradually degenerated into cancer. The presence of an ulcer is usually accompanied by symptoms which



were absent in Napoleon's case. He experienced a knife-like pain for the first time only a few months before his death. Could a

physicians, but who was not present at the autopsy, having left the island of St. Helena two years prior to Napoleon's

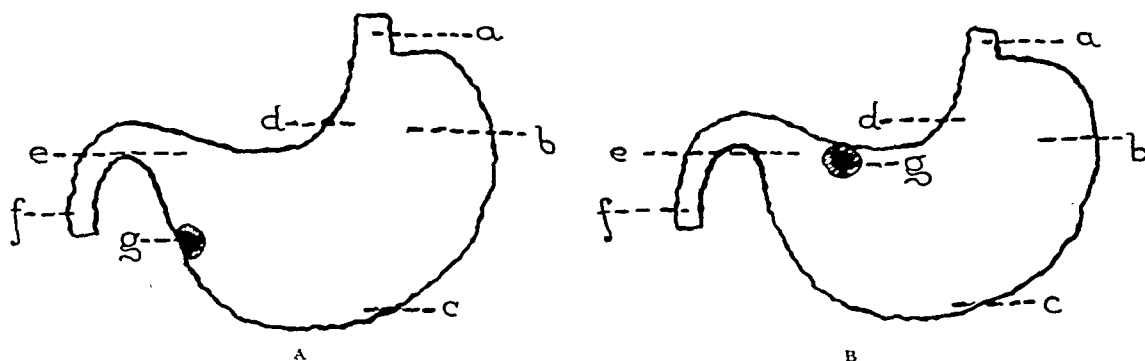


FIG. 1. A, diagram showing the approximate center of tumefaction (g) in the stomach of Charles Bonaparte, Napoleon's father. B, approximate center of tumefaction in the stomach of Napoleon Bonaparte. a, esophagus; b, cardiac end of stomach; c, greater curvature; d, lesser curvature; e, pylorus; f, duodenum.

benign ulcer have progressed so rapidly in eight months so that practically two-thirds of the stomach was affected? We do not think so. The whole history of Napoleon's last illness indicates a malignancy of the lesser curvature of the stomach—probably an infiltrating adenocarcinoma which gradually became ulcerated. This diagnosis is confirmed by the general condition of the patient, which was typical of cases of malignancy. The fact remains, however, that a definite diagnosis was made only after his death, although he had been attended by several physicians.

The following diagrams show the location of the tumors in the stomachs of Charles and Napoleon Bonaparte, according to the autopsy findings. (Fig. 1.)

Some years ago (1912-1913) there was a discussion in the *British Medical Journal* concerning the condition of Napoleon's intestines. The fact is that in the British Museum of the Royal College of Surgeons, there are two fragments of intestines labelled, "Incipient Fungus in the Glands of the Intestines of Napoleon." The authenticity of these pieces is very doubtful, according to Dr. Arnold Chaplin.<sup>8</sup>

Sir Astley Paston Cooper,<sup>9</sup> the famous pathologist of the last century, was the donor of these fragments to the museum. It seems that he had received them from Dr. O'Meara, who was one of Napoleon's

death. Sir Astley Cooper, judging from the histologic sections made of these fragments, considered that they showed cancerous metastasis of the intestines. If this is so, then one should presume that cancer of the stomach was of long standing and that it originated much earlier than the clinical symptoms. However, another histologic survey, made a hundred years later by Dr. A. Keith,<sup>10</sup> showed that these pieces did not at all present a picture of cancerous metastasis, even if they were authentic. Keith himself thinks that the fragments present a lymphoid hyperplasia due to attacks of malaria. Outside of the fact that the authenticity of these fragments is more than doubtful, Keith's investigation has no connection with the primary malignancy of Napoleon.

As autopsies on the bodies of the other members of the Bonaparte family were not performed, only clinical observations concerning them are available. An exception is Napoleon's son, the young Duke of Reichstadt, who died at the age of twenty-one from acute pulmonary tuberculosis (Dr. Malfati).

Elisa, Napoleon's eldest sister, suffered from dyspepsia from youth. A diagnosis of hypochondriasis and gastritis was made by Dr. Barthéz of Carcassonne and Professor Touquet of Montpellier. At the age of 40, there was a pronounced hematopedesis,

gastric symptoms, nausea and frequent vomiting, and a continuous fever. She died at the age of 43. Gastric cancer was suspected.

Pauline, Napoleon's second sister, complained of gastric symptoms for years.

Jerome, Napoleon's youngest brother, was diabetic and died of pneumonia at the age of 76.

The following table summarizes the data concerning these members of the Bonaparte family:

JOSEPH BONAPARTE (Died at the age of 40. Cancer of the stomach suspected.)							
CHARLES BONAPARTE (Died at the age of 39 of scirrhus carcinoma of the stomach.)							
ELISA	PAULINE	CAROLINE	NAPOLÉON BONAPARTE	JOSEPH	LUCIEN	LOUIS	JEROME
(Died at the age of 49. Cancer of stomach suspected.)	(Died at the age of 44. Cancer of the stomach suspected.)	(Died at the age of 56. Cancer of the stomach.)	(Died at the age of 52. Adenocarcinoma (?) of stomach.)	(Died of cerebral hemorrhage.)	(Died at the age of 65. Cancer of stomach suspected.)	(Died at the age of 68 of apoplexy.)	(Died at the age of 76 of pneumonia.)
NAPOLÉON II. Duke of Reichstadt. (Died of pulmonary tbc. at the age of 21.)							

During the last three years of her life she refused all food. She died at the age of 44. Physicians suspected that the cause was phthisis and cancer of the stomach.

Caroline, Napoleon's youngest sister during the last two years of her life suffered from jaundice and stubborn vomiting. Two lesions were found, one in the stomach and the other in the colon, the latter appearing to be secondary. The diagnosis, made by her physician Dr. Playfair, was carcinoma of the stomach.

Joseph, Napoleon's eldest brother, suffered from nephritis (Dr. Dubois). There were signs of a gastric disturbance. He died from cerebral hemorrhage.

Lucien, Napoleon's second brother, during the last years of his life, complained of pain and gastric symptoms—nausea and vomiting, accompanied by icterus. He died at the age of 65. Cancer of the stomach was suspected.

Louis, Napoleon's third brother, died of apoplexy at the age of 68. He complained at times of gastrointestinal disturbance. His son, Napoleon III, died in 1873 of pyelonephritis.

Although only three members of Napoleon's family unquestionably suffered from malignancy of the stomach—his father, himself and his sister, Caroline—four other members are suspected to have been victims of cancer. In general, the majority of Napoleon's generation suffered from gastric dysfunction and manifested from their youth symptoms of dyspepsia and gastritis. However, the following generations of this family were completely free from incidence of malignancy.

DISCUSSION

Bonaparte's family presents an interesting case of familial predisposition to cancer, particularly because the malignancy originated in the stomach. The recent work by Loeb, Lacassagne and others has somewhat clarified the obscure question of cancer heredity.<sup>11,12</sup> From their extensive laboratory experiments, it seems evident that there does not exist such a thing as the simple transmission of cancer by inheritance. According to these authors, the difficulty of forming a line of non-cancerous homozygotes is not compatible with the

idea that cancer depends upon a simple Mendelian factor. Therefore, the theory defended by Maud Slye did not receive support in these more recent experiments on this subject. Nevertheless, the inherited predisposition to malignancy is still considered a prime factor in the occurrence of cancer in animals. The hormonal pathogenesis of adenocarcinoma of the breast in mice has given conclusive evidence in this respect. From these experiments, we may see that mice from a low incidence line of cancer are resistant to heavy doses of carcinogenic hormonal substances, such as estrin. And again, mice of pure strain with a high incidence of cancer are extremely sensitive, even to relatively small doses of estrin. Their predisposition to cancer is such that not only the female, but even the male, may develop cancer of the breast after application of estrin.

Leo Loeb demonstrated that incidence of the breast in mice of a pure strain can be considerably increased by carcinogenic hormonal substance. But as soon as the purity of the line is broken by heretozygosis, this predisposition to cancer is reduced, or even completely annihilated. The nature of predisposition to malignancy has not yet been determined, but it may have some relation to glandular physiology. We know that large doses of estrin produce hyperplasia of the glandular system, particularly of the anterior pituitary and adrenal cortex (Burrow, Cramer<sup>13</sup>).

Referring again to the Bonaparte family, we may note that cancer occurred only in the first two generations. In the next two generations, the predisposition to cancer seems to have been broken by heterozygosis. Therefore, Masson's statement needs substantial corroboration. Among the eleven members of the older generation of Bonapartes, three were undoubtedly afflicted with cancer and four of them were

suspected cases of malignancy; but among the thirty members of the younger generation, not one suffered from this disease. Thus, the predisposition to cancer in the Bonaparte family was pronounced in practically but one generation, that of Napoleon.

An analysis of Bonaparte's case may convince one that *human predisposition to cancer is a phenomenon of an unstable, variable nature, which is easily broken by marriage*. It is therefore of doubtful practical value in the prognosis of malignancy. Although familial predisposition should be taken into consideration, its importance must not be overestimated. However, a study of families with cancer incidence is of prime importance for our better knowledge of cancer predisposition among humans. An analysis of the Bonaparte family seems to be in complete accord with recent experimental data.

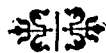
I wish to thank Dr. Leo Loeb, head of the Department of Pathology of Washington University Medical School for his valuable suggestion in connection with Napoleon's case.

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